ENERGY OVERVIEW STUDY OF ALBERTA'S REMOTE COMMUNITIES

Prepared for the
Remote Community Demonstration Program
of
Energy, Mines and Resources Canada

by
R.L. Walker and Partners Ltd.

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REMOTE COMMUNITY DEMONSTRATION PROGRAM

TABLE OF CONTENTS

LETTER OF TRANSMITTAL

ACKNOWLEDGEMENTS

EXECUTIVE SUMMARY

CHAPTER 1 Introduction

1.1	Objectives and Methodology of the Study	1
1.2	Other Federal and Provincial Programs in the Energy Sector	3

CHAPTER 2 Current Energy Demand and Supply in Remote Alberta Communities

2.1	Introduction	5
2.2	Overview of Historical Energy Supply and Demand	9
2.3	Fort Chipewyan	16
2.4	Fox Lake	17
2.5	Jean d'Or Prairie	23
2.6	Trout Lake	27
2.7	Peerless Lake	30
2.8	Chipewyan Lake	32
2.9	Peace Point	35
2.10	Other Communities	36
2.11	Energy Prices	38

CHAPTER 3 Future Energy Demand, 1985 and 1990

3.1	Introduction	41
3.2	Summary of Potential Energy Demand for Eight Isolated Communities	42
3.3	Fort Chipewyan	46
3.4	Jean d'Or Prairie	48
3.5	Fox Lake	49
3.6	Trout Lake	50
3.7	Peerless Lake	51
3.8	Chipewayn Lake	52
3.9	Peace Point	53
3.10	Garden Creek	54

CHAPTER 4 Energy Resources near the Remote Communities

4.1	Petroleum (crude) and natural gas	55
4.2	Hydro power	56
4.3	Peat and coal	56
4.4	Wood	57
4.5	Wind	59
4.6	Solar	59
4.7	Waste heat from diesel generating plants	60

CHAPTER 5 Preliminary Economic Evaluation of Some Alternative Energy Sources

5.1 Wood gasification for electricity production 61
5.2 Natural gas pipelines 63
5.3 Waste heat recovery from diesel engines 65
5.4 Electricity transmission line 67
5.5 Substitution of wood for propane or heating oil 68
5.6 Small hydro project at Vermilion Falls 70
5.7 Other energy sources 71

CHAPTER 6 Energy Conservation - Demand Reduction Measures

6.1 Residential sector 72
6.2 Commercial and institutional sector 75

CHAPTER 7 Barriers to Demand Reduction or Fuel Substitution

7.1 Financial barriers 78
7.2 Technological barriers 79
7.3 Information barriers 80
7.4 Institutional barriers 80
7.5 Summary 80

CHAPTER 8 Findings and Conclusions 81

CHAPTER 9 Possible Demonstration Projects 83

APPENDICES

Appendix 1: References
Appendix 2: Photographs of Representative Structures in Remote Communities in Alberta

ANNEXES

Annex A Federal and Provincial (Alberta) Energy Conservation and Off-Oil Programs
Annex B Data on Energy Consumption for Northlands School Division Facilities in Remote Communities
Annex C Alberta Power Tariff Schedule for Isolated Service
Annex D Fort Providence Wood Gasification Project Summary and Present Value Costs for 25 years
Annex E Costs of Natural Gas service to Jean d'Or Prairie and Chipewyan Lake
Annex F Costs of Electricity Supply for the Period 1983 - 2007

LIST OF TABLES

Table 1.1	Energy Content of Different Fuels	3
Table 2.1	Communities Visited	5
Table 2.2	Remote Communities Transportation Methods	8
Table 2.3	Energy Consumption in Remote Alberta Communities, 1982	10
Table 2.4	Electricity Plant Installed Capacity, Peak Demand, and Fuel Storage Capacity, 1982	11
Table 2.5	Annual Electricity Generation, MWh, 1978-1982	12
Table 2.6	Fuel Consumption at Diesel Generating Stations, m^3	13
Table 2.7	Peak Demand for Electricity, Kilowatts	13
Table 2.8	Consumption of Petroleum Products and Wood, 1982	14
Table 2.9	Energy Use in Fort Chipewyan, 1982	20
Table 2.10	Energy Use in Fox Lake, 1982	23
Table 2.11	Energy Use in Jean d'Or Prairie, 1982	26
Table 2.12	Energy Use in Trout Lake, 1982	29
Table 2.13	Energy Use in Peerless Lake, 1982	32
Table 2.14	Energy Use in Chipewyan Lake, 1982	34
Table 2.15	Estimated Energy Use in Peace Point, 1982	36
Table 2.16	Prices of Petroleum Products, 1983	38
Table 3.1	Projected Demand for Energy in 1985	43
Table 3.2	Projected Demand for Energy in 1990	44
Table 3.3	Summary of Estimated Energy Consumption by Source for Eight Communities	45
Table 3.4	Estimated Future Demand for Non-Renewable Energy Products in Eight Isolated Communities (excluding transport)	45

EXECUTIVE SUMMARY

A remote Community Demonstration Program was introduced in 1982, as part of the Federal Government's Off-Oil objectives. Part I of the Program is designed to assess the scope for alternative energy supplies and conservation by developing a comprehensive data base and screening approaches to reduced oil use. Later Phases will be concerned with more-detailed study of potentially-attractive options and implementation of demonstration projects.

This report analyzes existing and probable future energy supply and demand scenarios for eight remote communities in Alberta. These communities all depend on diesel fuel for electricity generation and on heating oil or propane for space heating in institutional and commercial buildings. Wood, rather than heating oil or propane, is the main source of energy for residential space heating and cooking.

The report describes the communities and their energy use and includes projections of probable future use. Based on these projections and the availability of energy sources, preliminary assessments are made of alternatives to existing energy supplies. The opportunities for reducing oil consumption through conservation are also reviewed.

The existing situation is described in Chapters 1 and 2. Chapter 3 contains projections of fuel use (excluding fuel used for transport) in all eight isolated communities in Alberta to the year 1990. The projected total demand for oil-based fuels is estimated at 4,100 m^3 of diesel oil and 2,100 m^3 of heating oil.

In Chapter 4, alternative sources of energy which could be considered as potential sources of replacement for petroleum-based fuels in these communities are discussed. This is followed, in Chapter 5, by a preliminary economic evaluation of some of the, apparently, more-attractive substitution possibilities. There could be scope for connection to either the electric power grid or the gas distribution grid in the cases of Jean d'Or Prairie and Fox Lake and there is also a potential for development of a small hydro plant at Vermilion Falls between these communities.

Chipewyan Lake could obtain gas from a nearby gas field. Waste heat recovery from diesel plants could be an attractive option but is currently not economic in most communities due to the distances between major users of energy for space heating and the diesel plants. This option should be considered when new plants are built. Power plant relocation could be consideredin some existing communities. Current relative prices of oil, propane and wood make direct substitution of wood for oil and propane* unattractive in Alberta for the purpose of space heating of large buildings. The same applies to wood-gasification installations although the demonstration project at Fort Providence, Northwest Territories, should be monitored to determine whether such projects are desirable for use in Alberta. The manufacture of charcoal from wood cut for highways, pipelines, seismic lines and agricultural clearing has been found to be potentially attractive. This wood is currently burned as waste.

Energy conservation is discussed in Chapter 6. Significant opportunities exist in schools, other official buildings and in commercial establishments. Barriers to energy conservation and fuel substitution are discussed in Chapter 7. Several of the more important barriers could be removed by attention to appropriate building standards, institutional relationships, financial incentives and dissemination of information regarding current technologies and programs.

Conclusions and Findings are presented in Chapter 8. Finally, in Chapter 9, some suggestions are made regarding demonstration projects which could be pursued during the next phase of the Remote Community Demonstration Program in several remote communities in Alberta. Some further work would be necessary to determine whether such projects should be pursued but among those suggested are a small hydro project, waste heat recovery from diesel engines, and a concerted effort on a community level to conserve energy.

* Propane is not in short supply in Alberta since it is a by-product of natural gas production. The analysis of substituting wood for propane was performed to determine whether the communities studied can become more self-reliant using nearby resources.

ETUDE GENERALE DES QUESTIONS ENERGETIQUES

DANS LES COLLECTIVITES ELOIGNEES DE L'ALBERTA

Résumé pour la Direction

Le Programme de démonstration dans les collectivités éloignées a été mis en place en 1982 pour répondre aux objectifs du gouvernement fédéral concernant le remplacement du pétrole. Lors de la première phase de ce programme, il est prévu d'évaluer l'ampleur des économies d'énergie susceptibles d'être réalisées ainsi que les possibilités offertes par les autres sources d'énergie en élaborant une base de données exhaustive et en passant en revue les différentes méthodes susceptibles d'amener une réduction de la consommation de pétrole. Au cours des étapes suivantes, il s'agira d'étudier plus en détail les options qui apparaissent intéressantes et de mettre en application des projets-pilotes.

Le présent rapport fait l'analyse des schémas existants ainsi que des différents scénarios susceptibles de se réaliser à l'avenir en matière d'offre et de demande d'énergie dans les huit collectivités éloignées de l'Alberta. Ces différentes collectivités dépendent toutes du combustible diesel pour la production d'électricité et du mazout ou du propane pour le chauffage des locaux des bâtiments administratifs ou commerciaux. C'est le bois, et non le mazout ou le propane, qui est la principale source d'énergie dans les locaux résidentiels, qu'il s'agisse de chauffage ou de cuisine.

Le rapport passe en revue les collectivités en ce qui a trait à leur consommation énergétique et établit des prévisions concernant le futur. En se fondant sur ces prévisions et sur la disponibilité de ressources énergétiques, une première évaluation des possibilités de remplacement des sources d'énergie utilisées à l'heure actuelle est effectuée. La possibilité de réduire la consommation de pétrole grâce aux économies d'énergie est par ailleurs étudiée.

La situation actuelle est décrite aux chapitres 1 et 2. Le chapitre 3 établit des prévisions au sujet de la consommation d'hydrocarbures (y compris de ceux qui sont utilisés dans les transports) dans huit collectivités isolées de l'Alberta jusqu'en 1990. La prévision de la demande totale d'hydrocarbures porte sur 4 100 m^3 de combustible diesel et 2 100 m^3 de mazout.

Le chapitre 4 étudie la question des sources d'énergie de rechange susceptibles de remplacer les hydrocarbures. Cette discussion est suivie, au chapitre 5, d'une première évaluation économique des solutions qui paraissent, à première vue, les plus envisageables. Un raccordement

est possible aux réseaux d'alimentation électrique ou de distribution de gaz dans les cas de Jean d'Or Prairie et de Fox Lake et l'aménagement d'une petite installation hydro-électrique à Vermilion Falls, entre ces deux collectivités, est par ailleurs envisageable.

Chipewyan Lake pourrait s'approvisionner en gaz à partir d'un gisement de gaz proche. Le recyclage de la chaleur récupérée dans les installations diesel pourrait offrir des possibilités intéressantes, mais cette solution n'est pas rentable à l'heure actuelle dans la plupart des collectivités étant donné les distances qui séparent les installations diesel des principaux utilisateurs d'énergie consacrée au chauffage des locaux. Cette option pourrait être envisagée lors de la construction de nouvelles installations. On pourrait penser, dans certaines collectivités, à déplacer les installations électriques. Les prix relatifs du pétrole, du propane et du bois font qu'il n'est pas rentable de remplacer directement le pétrole et le propane par le bois en Alberta pour chauffer de grands bâtiments. Il en est de même en ce qui a trait aux installations de gazéification du bois, bien que l'on devra suivre le déroulement du projet-pilote de Fort Providence, Territoires du Nord-Ouest, au cas où il pourrait s'appliquer à l'Alberta. La fabrication de charbon de bois à partir des coupes de bois correspondant au passage des routes, des oléoducs, des lignes antisismiques ainsi qu'au défrichage des terrains agricoles a été jugée potentiellement intéressante. A l'heure actuelle, ce bois est brûlé en tant que déchet.

Les économies d'énergie sont traitées au chapitre 6. Un potentiel intéressant existe dans les écoles, dans les différents bâtiments officiels et dans les établissements commerciaux. Les obstacles qui s'opposent aux économies d'énergie et au remplacement du pétrole sont exposés au chapitre 7. Il serait possible d'en supprimer un certain nombre, parmi les plus importants, en se préoccupant des normes de construction des bâtiments, des liens existants entre les institutions, des incitations financières possibles et de la diffusion de l'information touchant les techniques et les programmes nouveaux.

Les résultats et les conclusions sont présentés au chapitre 8. Le chapitre 9, pour finir, présente un certain nombre de propositions touchant les projets-pilotes susceptibles d'être implantés au cours de l'étape suivante du Programme de démonstration dans les collectivités éloignées qui s'adresse aux différentes collectivités isolées de l'Alberta. D'autres études seront nécessaires pour déterminer dans quelle mesure ces projets doivent être maintenus, mais on trouve des propositions portant sur un petit projet hydro-électrique, une installation de recyclage de la chaleur dégagée par les moteurs diesel et un projet d'harmonisation des efforts effectués au sein de la collectivité pour économiser l'énergie.

Cette étude a été effectuée en 1983 par R.L. Walker and Partners Ltd. dans le cadre du Programme de démonstration dans les collectivités éloignées d'Energie, Mines et Ressources Canada.

* Le propane n'est pas une denrée rare en Alberta puisqu'il s'agit d'un sous-produit du gaz naturel. L'analyse du remplacement du propane par le bois avait pour but de déterminer jusqu'à quel point les collectivités étudiées pouvaient devenir auto-suffisantes en tirant parti des ressources de leur environnement.

CHAPTER 1

INTRODUCTION

1.1 Objectives and Methodology of the Study

This study is part of Phase I of the Remote Community Demonstration Program which was introduced in 1982 as part of the Federal Government's Off-Oil objectives*. The four-year program of financial assistance and information transfer is designed to help promote the adoption of alternative approaches to energy supply and to energy conservation in remote communities. It is aimed specifically at power generation and space heating on a community scale. Its goal is to reduce dependence on oil and broaden awareness of more appropriate (and often locally available) renewable fuels, conservation methods, and other practical alternatives.

Phase I of the program involves studies to establish a data base on energy consumption and supply and to perform a preliminary screening of alternative approaches to energy supply or conservation. In Phase II, the program will provide financial assistance for demonstrations of practical, effective, and economic projects in supply and conservation of energy. The program will be in operation from October 1982 to March 1986.

To be eligible for the program, communities must be permanent and have no less than ten occupied dwellings. All such communities in the Yukon Territory or Northwest Territories are eligible. In the provinces, communities must also be off the main electrical grid and not served by natural gas pipelines. If there is a firm commitment for connecting to either of these services, the community is not eligible.

* In Alberta, propane is not considered as an oil-based product since most of the production is associated with natural gas not refinery operations. In this report, consideration of substitution for propane is based on increasing the reliance of the communities on local resources.

The objective of this study as stated in the Request for Proposals was to prepare a concise profile of the energy demand and supply for each eligible remote community in Alberta. The scope of the study included:

a) identifying the energy suppliers and quantities consumed, by sector and fuel, including energy costs;

b) reviewing community composition, including an assessment of the buildings from an energy standpoint;

c) projecting future energy consumption;

d) reviewing the availability of local energy resources;

and

e) identifying and assessing opportunities for using local energy resources and for conserving energy.

The methodology for this study included a review of all relevant data available on the selected communities as compiled by provincial and federal agencies and energy supply companies. The communities were then visited to assess the condition of buildings and to meet with community representatives who might be interested in pursuing projects under Phase II. To obtain a cross-section of views on energy sector issues and options, interviews were conducted with Indian Band Council members, local government members, petroleum product retailers, teachers, general store managers, power company service and operating personnel, social workers, community health workers and other residents. Discussions were also held with provincial and federal employees in administrative centres regarding current services and future plans for the communities.

The options for alternatives to existing energy systems have been evaluated, based upon a 25-year economic life. A real discount rate (net of inflation) of 6 percent has been used and the real fuel price escalation has been based on Energy, Mines and Resources projections of 1982. Costs for various options have been obtained from Alberta Power Limited, the provincial government, and private suppliers of equipment. These evaluations must be considered as preliminary screening tests; more work will be necessary before decisions are made.

For the various energy sources the following energy contents are used.

TABLE 1.1

Energy Content of Different Fuels

Fuel	Energy Content[1]
diesel oil	36.5 MJ/litre
heating oil	38.5 MJ/litre
propane	25.6 MJ/litre
natural gas	35.3 GJ/m^3
wood[2]	13.7 GJ/cord

1 MJ = megajoule = 10^6 Joule
GJ = gigajoule = 10^9 Joule

2 air-dried spruce and poplar per stacked cord

The costs of energy from the different sources are included in Chapter 5 of the report.

1.2 Other Federal and Provincial Programs in the Energy Sector

As a result of various government policies (both federal and provincial) there are numerous programs which are directed towards energy supply from sources other than oil or gas or energy conservation. The Remote Community Demonstration Program (RCDP) is one of the Federal programs which serve the overall objective of reducing oil consumption. Some of the other programs have broader objectives than RCDP but they can be considered complementary. On the other hand, some programs are more specific (e.g. efficient housing) and their results could be considered as inputs for Phase II of the RCDP.

The programs in effect in 1982 are described in the comprehensive "Compendium of Federal and Provincial Energy Conservation and Off-Oil Programs" which was compiled by Middleton Associates. A summary of the programs which could have an impact on energy use in small communities is included in Annex A.

The multitude of programs which have some relevance to energy savings in small communities obviously causes problems in awareness and effectiveness. The dissemination of information such as this seldom reaches isolated areas effectively unless some special effort is made to coordinate the information flow. As a consequence, the level of awareness for both federal and provincial programs is low and few programs are used by residents in remote communities. For example, there have been few, if any, participants in the COSP or CHIP programs although almost all users of heating oil in Fort Chipewyan apply for the Remote Area Heating Allowance Rebates. This probably stems from the fact that many of the houses in some of these communities are not owned by the occupants. These residents do not have the same incentive to improve the structure as a homeowner would have. This situation applies equally to Native housing owned by the Indian Bands and to non-native housing owned by the provincial or federal governments.

Homeowners are generally aware that energy is costing increasingly more and some, a minority, are making changes such as installing wood stoves (often without benefit of COSP grants) or building efficient housing. However, for those who are on social assistance, cost of energy is not a major factor since utility bills are covered by the assistance.

Education administrators are generally poorly informed of the province's programs for schools (both education programs and operation and retrofit programs). Additionally, while most of the schools are built to reasonable standards, the heating systems are not being operated efficiently and they could benefit from the province's School Conservation Program (see Chapter 6 for conservation opportunities).

The pattern of energy use in these remote communities is different than in urban centres or more accessible rural areas because of the lifestyle of the residents and programs will have to be aimed at them specifically if they are to be effective. This aspect is important since the communities will most likely become more dependent on costly energy if services such as running water are provided in the next few years as planned. To overcome existing problems with information flow it is important that a single office or agency has the responsibility for providing information on all energy programs that are applicable for the remote communities.

CHAPTER 2

CURRENT ENERGY DEMAND AND SUPPLY IN REMOTE ALBERTA COMMUNITIES

2.1 Introduction

Alberta has an extensive electricity grid and widespread distribution of natural gas and, as a consequence, few communities meet the criteria for this program as outlined in Chapter 1. Of the total population of 2.24 million in 1981, less than 4,000 people or 0.2 percent lived in remote communities considered eligible under this program. The communities selected for site visits are described in this chapter and listed below. Their locations are shown on Figure 1*. Brief descriptions of several other small communities are also provided.

TABLE 2.1

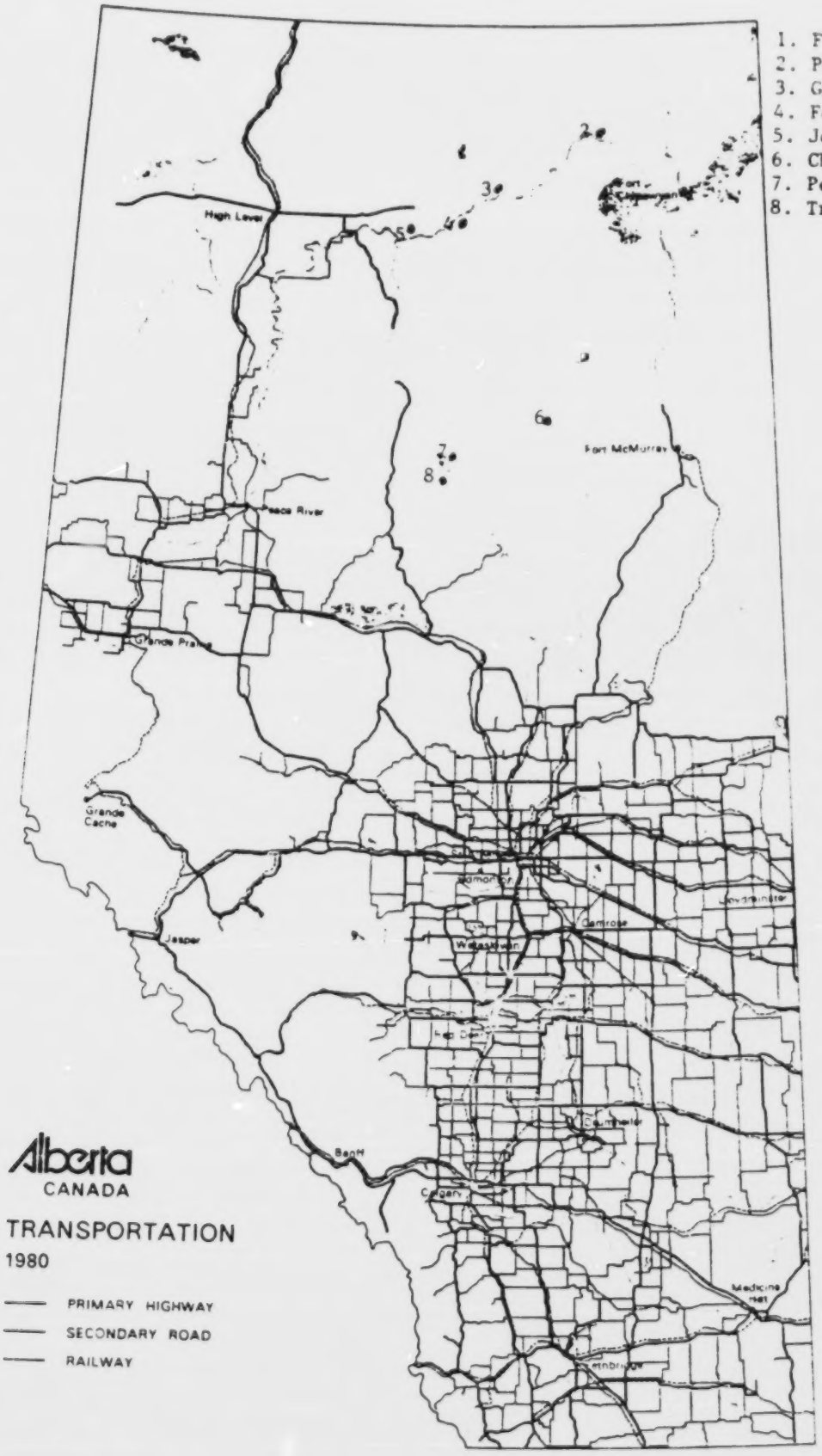
Communities Visited

	Population
Fort Chipewyan	1,600
Jean d'Or Prairie	650
Fox Lake	750
Trout Lake	203
Peerless Lake	204
Chipewyan Lake	150
Peace Point	67
Total	3,624

The communities are all quite similar with the population consisting primarily of Native or Metis people with a small number of non-Natives, employed in government (teaching, health services) or service (retail) occupations. Incomes are derived from activities based on natural resources with the main occupations being trapping, fishing, hunting and forestry (including fire fighting). Jean d'Or Prairie, Fox Lake and Peace Point are administered by Indian Band councils with assistance from Indian and Northern Affairs Canada while the other communities are administered through the Improvement Districts division of the Alberta Municipal

* The location of Garden Creek is also shown on the map. This community was not visited but it has been included in the estimate of future demand for energy. Population is about 150.

FIGURE 1


1. Fort Chipewyan
2. Peace Point
3. Garden Creek
4. Fox Lake
5. Jean d'Or Prai
6. Chipewyan Lake
7. Peerless Lake
8. Trout Lake
High Level
Fort McMurray
Peace River
Grande Prairie
Grande Cache
Jasper
Edmonton
Lloydminster
Camrose
Wetaskiwin
Red Deer
Drumheller
Banff
Calgary
Medicine Hat
Alberta
CANADA
TRANSPORTATION
1980
PRIMARY HIGHWAY
SECONDARY ROAD
RAILWAY

Affairs Department. Local representatives are elected to advisory councils which assist Municipal Affairs in routine administration and in setting policy for the communities not administered by Indian and Northern Affairs.

Housing in the communities varies in age, condition, and in type and quantity of energy used. In general, the Native and Metis families use small amounts of electricity (lighting, small appliances) with wood providing the energy needed for space heating, cooking, and water heating. A small percentage of these families use propane or electricity for cooking. Fort Chipewyan is an exception to this trend and heating oil is used for space heating in about forty percent of all homes and propane in about ten percent. By contrast, housing for non-Natives is more modern and a full range of appliances is used. For most of these families, housing is built by a government agency (Health and Welfare, Department of Education) and bills for energy use are paid by the agency. Propane is the predominant fuel used for space heating in these non-Native residences in all communities except Fort Chipewyan and Peace Point where heating oil is the primary fuel.

Electricity is provided to all of the communities from diesel generating plants owned and operated by Alberta Power Limited, except in Peace Point which has a small Band-owned generator. A larger plant is due to be installed this year (1983) by Alberta Power Limited. The fuel for the plants is obtained on tender and is delivered to the plant site by the supplier. Storage capacity varies according to the access and the size of the plant. Supply of electricity is not limited except that space heating loads are not permitted.

The communities which were visited have limited access to the main transportation and energy networks of the province. These features are illustrated in Table 2.2 which shows the transportation means (winter and summer) and the distances to the nearest electricity and natural gas services.

The following section gives an overview of energy use in the communities with more detailed discussion in the remainder of this chapter. Chapter 3 contains the projections of energy demand in 1985 and 1990.

Data on energy use in these communities are not compiled in any single source and it was necessary to rely on suppliers' and users' estimates. Electricity statistics are the most reliable while consumption figures for other fuels are based on less reliable estimates. Heating oil consumption for Fort Chipewyan is based on the major seller's estimate of

TABLE 2.2

Remote Communities Transportation Methods

Community	Transportation		Distance (km) to:	
	Summer	Winter	Electricity Grid	Natural Gas Services
Fort Chipewyan*	Scheduled Air Barge	Scheduled Air Winter Road	175	280
Fox Lake	Scheduled Air (Light plane)	Scheduled Air Winter Road	90	90
Jean d'Or Prairie	Schedule Air (Light plane) All-weather road	Scheduled Air All-weather road	45	45
Chipewyan Lake	Air (Charter)	Air (Charter) Winter Road	110	200
Paerless Lake	Unimproved road	Unimproved road	45	150
Trout Lake	Unimproved road Air (Charter)	Unimporvai road Air (Charter)	40	140
Peace Point	All-weather road	All-weather road	220	220

* Access during freeze-up and break-up periods is limited to air service.

sales and on his suppliers' shipment data. For propane consumption, the major user (Northlands School Division) provided information on the total cost for each community and the average price. The allocations to schools and residences appeared to be out of proportion to the floor areas in some communities so adjustments were made. The propane consumption of other small users was estimated. Wood consumption is based on observations in the communities, discussions with builders of new homes, and estimates from other studies. This lack of consistency in the data introduces some uncertainty in the estimates of current energy use and also the projections of future use contained in Chapter 3.

2.2 Overview of Historical Energy Supply and Demand

As noted above, the energy supply and use patterns have common characteristics in the communities studied. Electricity is provided from Alberta Power Limited's diesel plants; wood is the primary residential fuel; propane is used for space and water heating in institutional buildings and non-Natives' homes, heating oil is not a major fuel except in Fort Chipewyan; and per capita consumption of energy is low compared with the provincial average. The seasonal use of energy follows a predictable pattern: use of heating fuels and electricity is highest in the winter when lighting and heating are needed. The only seasonal data available are for electricity and these are not included in this report. The tables in this Section present these data in summary form. Details for each community are provided in Sections 2.3 to 2.9.

In addition to the fuels used for residential and institutional purposes, there are transportation fuels consumed which are not considered in this study. Gasoline is used in trucks, cars, snowmobiles, and chain saws while diesel is used in construction and farm vehicles and a small number of trucks and cars. Some small volumes of kerosene are used for lighting and for starting fires and these volumes are not estimated.

The total energy use in each of the communities (except for transportation fuel) is summarized in Table 2.3 along with indicators of per capita consumption. Energy use in the remote communities is low when compared with the province-wide figure of 335 GJ per capita in 1978. Per capita consumption of electricity in Alberta was 8,650 kWh in 1978 (or 104 GJ if thermal generation at thirty percent efficiency is assumed) compared with an average of 1,670 kWh per capita (22.2 GJ) for these communities in 1982. However, energy usage in the communities of Trout Lake, Peerless Lake and Chipewyan Lake appears much higher, on a per capita basis, than expected. This is discussed in more detail later in this chapter.

The capacities of the diesel generating plants which Alberta Power Limited owns and operates, and the fuel storage capacity at each location, are presented in Table 2.4. Tables 2.5 and 2.6 show the annual electricity generation and fuel consumption, respectively, for the period 1978 to 1982. Table 2.7 shows the peak demands in each community for 1978 and 1982.

TABLE 2.3

Energy Consumption in Remote Alberta Communities, 1982

Community	Population	Energy Use (GJ)		Energy Use per Capita (GJ)	
		Total	Electricity[1]	Total	Electricity
Fort Chipewyan	1,600	114,000	42,100	71.3	26.3
Jean d'Or Prairie	650	30,970	10,330	47.6	15.9
Fox Lake	750	38,470	12,840	1.3	17.1
Trout Lake	203	16,120	5,650	79.4	27.8
Peerless Lake	204	16,810	5,720	82.4	28.0
Chipewyan Lake	150	10,260	2,520	68.4	16.8
Peace Point[2]	65	2,200	500	33.8	7.7
TOTALS	3,585	228,830	79,660	63.9	22.2

1. Energy Content of the fuel consumed for electricity generation.

2. Estimated

Source: Electricity use is from Alberta Power Limited. Other energy is from user and supplier data and from estimates of total wood use. Population is based on Alberta Municipal Affairs and Indian and Northern Affairs Canada data.

TABLE 2.4

Electricity Plant Installed Capacity, Peak Demand, and Fuel Storage Capacity, 1982

Community	Installed Units kW	Total Capacity kW	Peak Demand kW	Fuel Storage m^3
Fort Chipewyan	1 x 800 2 x 500 1 x 300	2,100	1,020	705
Fox Lake	2 x 250	500	200	396
Jean d'Or Prairie	1 x 250 1 x 200	450	163	45
Trout Lake	2 x 150	300	84	45
Peerless Lake	2 x 150	300	102	45
Chipewyan Lake	2 x 50	100	46	90
Peace Point*	2 x 40	80	-	45
Garden Creek*	2 x 125	250	-	90

* Planned for 1983

Source: Alberta Power Limited.

TABLE 2.5

Annual Electricity Generation, MWh, 1978 - 1982

Community*	1978	1979	1980	1981	1982	Average Annual Growth 1978-1982, %
Fort Chipewyan	2,632	2,788	2,906	3,295	3,815	9.7
Chipewyan Lake	100	130	149	149	178	15.5
Fox Lake	552	610	677	719	778	9.0
Jean d'Or Prairie	434	521	517	566	652	10.7
Peerless Lake	128	164	181	266	350**	28.6
Trout Lake	131	145	194	215	229	15.0

Source: Alberta Power Limited

* Data are not available for electricity generation at Peace Point or Garden Creek where the plants are not owned by Alberta Power Limited.

** Generation appears inconsistent with fuel consumption.

TABLE 2.6

Fuel Consumption at Diesel Generating Stations, m^3

Community*	1978	1979	1980	1981	1982
Fort Chipewyan	906	945	889	1,087	1,171
Chipewyan Lake	49	55	57	57	70
Fox Lake	247	277	292	323	345
Jean d'Or Prairie	225	235	222	239	293
Peerless Lake	62	107	108	160	159**
Trout Lake	55	78	83	135	157

Source: Alberta Power Limited

* Data are not available for fuel consumption at Peace Point or Garden Creek where the plants are not owned by Alberta Power Limited.

** Generation appears inconsistent with fuel consumption.

TABLE 2.7

Peak Demand for Electricity, Kilowatts

Community	1978	1982	Growth %/year
Fort Chipewyan	620	1,020	13.3
Fox Lake	152	200	7.1
Jean d/Or Prairie	115	163	9.1
Trout Lake	37	84	22.7
Peerless Lake	33	102	32.6
Chipewyan Lake	31	46	10.4

Source: Alberta Power Limited

Data on consumption of other fuels are not readily available for these small communities. The main users of petroleum products are schools, nursing stations, retail stores and residences for teachers with some small volumes of propane used for cooking in other homes and the estimates of demand are based on information from major users and suppliers. The amount of wood used is based on observations in the communities and on the number of residences using wood as the primary fuel. Table 2.8 shows the consumption of these fuels for year 1982. Transportation fuels are excluded for two reasons:

- the data are unreliable, and
- these fuels are not important to the Remote Community Demonstration Program.

It is clear from this table that the potential for substituting other fuels for petroleum products is not large.

TABLE 2.8

Consumption of Petroleum Products and Wood, 1982

Community	Propane m^3	Heating Oil m^3	Wood stacked cords
Fort Chipewyan	150	1,055	2,000
Fox Lake	419	14	1,050
Jean d'Or Prairie	263	45	900
Trout Lake	89	-	600
Peerless Lake	112	-	600
Chipewyan Lake	41	3	480
Peace Point*	-	8	100
Total	1,074	1,125	5,730

Residential use of electricity is limited to lights, washing machines, and some small appliances (irons, toasters, TV's, radios) in most homes except for non-Native homes where the full range of appliances is used. Few Native/Metis homes have electric water heaters, stoves or refrigerators. During the winter, vehicle block heaters increase electricity consumption. The predominant fuel for space heating and cooking in Native and Metis homes is wood with non-Natives using propane or heating oil. Fort Chipewyan has relatively more users of heating oil and propane (about 50 percent of homes) than the other communities (about 10 percent).

The amount of wood required for heating, cooking, and water heating has been estimated based on discussions with owners of homes in various communities and with Alberta Housing and Public Works employees involved in replacement housing. These homes varied from old, poorly insulated houses to new well-constructed houses built to standards developed by the provincial government through its Rural Home Assistance Program. The photographs in Appendix 2 illustrate the variation. Wood use varied from 5 stacked cords (18 cubic metres) per year to as high as 20 stacked cords (72 cubic metres) with the average estimated at close to 15 stacked cords (54 cubic metres). The study performed by Crippen for the Department of Indian and Northern Affairs (Ref.3) estimated that requirements for home heating would be about 15 cords (54 cubic metres) of solid wood or 24 cords (87 cubic metres) of stacked wood. The difference can probably be accounted for by the fact that the Crippen calculations were based on heating a home for 24 hours per day. In the study communities, fires are allowed to go out overnight because the homes generally have no running water and thus no need for freeze protection. Additionally, these houses are generally smaller than those found in the locations considered in the Crippen Study. The amount of wood used in each community shown in Table 2.8 is based on 15 cords per year for each house using wood as a primary fuel.

The energy used by the institutional and commercial sector was based on consumption figures provided by large users, if the data were available. The largest users in this sector are the schools and data for consumption of propane and heating oil at schools operated by the Northlands School Division are presented in Annex B. For electricity consumption, the sales to the residential sector were subtracted from total sales and the residual was assigned to the institutional and commerical sector. Users in the sector include schools, churches, nursing stations or health clinics, microwave towers, retail stores, government users (including Post Offices, Band Council offices, water pumping stations, recreational and community buildings), and in Fort Chipewyan, cafes and small motels.

The details of energy supply and consumption by sector are included in the following sections. The discussion is limited to exceptions to the above description of the sectors.

2.3 Fort Chipewyan*

2.3.1 General Description

The community of Fort Chipewyan is the oldest continuously inhabited settlement in Alberta with its origins as a transportation and trading post during the expansion of the fur trade into the Northwest. The first trading post was built at Old Fort Point on the south shore of Lake Athabasca in 1788. In about 1800 this location was abandoned in favour of the current location, near the mouth of the Rivière des Rochers which flows into the Slave River, where there are several advantages:

- better location on the waterways,
- better access to the food supplies of the Peace-Athabasca delta,
- more favourable winds,
- an earlier date for ice break-up in Lake Athabasca.

Before the trading post was established the Indians of the area (Chipewyan, Beaver, and Cree) led a nomadic life. Other details of the history can be found in Bahnuik and Wright's report and in the Socio-Economic Impact Assessment prepared in January 1979 in support of the Alsands Project.

Fort Chipewyan is the largest of the isolated communities in Alberta and has a population in 1983 of about 1500-1600 with the Cree Band being the largest group and the Chipewyan Band the second largest. Non-natives total about 70 people. The community has a new Federal Health Centre where the major programs are a T.B. detection program and a Well Baby Clinic. Emergency treatment is provided but patients must go to Fort McMurray for hospitalization. The two schools, one operated by Indian and Northern Affairs, the other by the Northlands School Division, provide education up to Grade 12. There are currently a total of 175 students and 10 teachers at the Bishop Piche School (Indian and Northern Affairs) which

* Much of this description is based on data in a report by Bahnuik and Wright which was prepared in June 1982 as part of the feasibility study of the Slave River Hydroelectric Project (Ref. 18).

includes Grades 4 through 12*. There are three church denominations in Fort Chipewyan: Roman Catholic, Anglican, and Baptist. Recreational facilities include a curling rink, a new recreation centre, baseball diamonds, and a hockey rink. The community has a new water and sewer system (not all houses are connected) and a fire hall with two trucks. There is a 3-man RCMP detachment in Fort Chipewyan. Telephone service is provided by Alberta Government Telephones, electricity by Alberta Power Limited, and radio and television broadcasts are received from CBC Yellowknife.

The condition of housing in Fort Chipewyan is predominantly poor by southern Canadian standards. In 1982 Alberta Power Limited had 268 residential customers, giving a good estimate of the number of houses. About 70 percent of the houses were built over 10 years ago and Alberta Housing and Public Works sources estimate that 20-30 percent of all houses need replacing. Only about 10-15 percent of the houses are owned by the occupants with the rest owned by the Cree or Chipewyan Band or by government agencies.

2.3.2.1 Energy Supply

Electricity is provided to residents and businesses in Fort Chipewyan from Alberta Power Limited's diesel generating station and statistics on electricity generation and fuel consumption are included in the tables in the previous section. There are two full-time employees in Fort Chipewyan who operate and maintain the system with support from personnel in Fort McMurray. Electricity is distributed through a 3-phase, 25 kV system and in 1982 there were 268 residential and 61 commercial customers for a total of 329 customers. Growth in electricity generation was 9.7 percent per year from 1978 to 1982 while peak demand grew at a rate of 13.3 percent. From 1980 to 1982, however, the growth in generation was 14.6 percent per year.

The largest retail outlet for petroleum products in Fort Chipewyan is a Gulf Canada agency. A second outlet has recently opened and is currently serving a small portion of the gasoline market. These dealers supply gasoline, diesel oil, heating oil, kerosene, and lubricating oils. Propane is supplied by ICG Propane at Hay River which delivers during the winter season. The other products are delivered by two routes:

* The school building burned in 1981 and classes are now held in temporary modular units. A new permanent facility is planned but the design has not been finalized.

- by barge from Fort McMurray down the Athabasca River during the summer, and

- by winter road from Fort Smith, Northwest Territories, after ice bridges on the Peace River and other channels have been formed.

There are two to four months each year during freeze-up and break-up when the only access to Fort Chipewyan is by air and during these periods fuel supply is normally interrupted. However, in the fall of 1981 the freeze-up occurred early and the barges carrying fuel from Fort McMurray were unable to reach Fort Chipewyan with the result that fuel had to be flown in by Hercules aircraft. Because of the need to provide petroleum products for these periods of isolation, storage capacity is large compared with annual demand. Commercial capacity is 450,000 litres each for diesel and heating oil and 300,000 litres for gasoline. This is additional to Alberta Power Limited's storage of 705,000 litres for diesel oil and Bishop Piche School's storage of 340,000 litres for heating oil. Other significant storage capacity exists at the water pumping station and at the nursing station.

The other major fuel used in Fort Chipewyan is wood. More than half of the homes use it as the primary fuel for cooking, space and water heating. The wood is gathered locally within 10 kilometres of the community and hauled by truck or snowmobile. Species of wood burned include aspen, black spruce and jackpine.

2.3.2.2 Energy Demand

The main energy sources for households in Fort Chipewyan are electricity, heating oil, propane and wood. Electricity is used as described in the previous section. Residential heating oil customers number about 100 - 110, with some using oil for space heating only while others use it in combination wood/oil stoves which serve both cooking and heating functions. Non-Native residents (about 25 households) generally have forced-air oil-fired furnaces for space heating with electric cooking and water-heating units. In addition to heating oil users, there are 18 - 23 families using propane as the primary heating fuel including the Northlands School Division primary school teachers. The teachers at the Bishop Piche School all use heating oil for space heating (10 units).

Average residential electricity consumption was 6,039 kWh during 1981 and 6,498 kWh in 1982, the highest value for the remote communities under study. This is probably due to the fact that:

- electricity has been available for a long period of time (about 25 years); and
- there is a larger percentage of non-Native residents in the community who tend to use more energy than Natives.

The increased consumption in 1982 can be partially attributed to the cold winter which would cause increased use of block heaters and additional consumption in forced-air heating systems. During that year the 268 residential customers consumed 1,741 MWh of electricity, equivalent to 49 percent of total 1982 sales of 3,560 MWh*. No breakdown of electricity use by sector is available for earlier years.

Residential consumption of heating oil in 1982, a particularly cold year, amounted to approximately 650,000 litres. Sales in 1981 were about 525,000 litres. Propane consumption is estimated at 100,000 litres for residential use in 1982 and 80,000 litres in 1981. No estimate of the volume of kerosene used was available.

Electricity use by the commercial and institutional sector equals total sales less residential sales or 1,819 MWh (51 percent of sales). There are 61 customers in this category ranging from schools and the health clinic to the post office and microwave towers. The sector is heavily weighted towards the government sector with retail and service businesses making up the rest.

Heating oil is used by the Bishop Piche School (Grades 4 to 12), the Northlands primary school, and by the health clinic. Alberta Municipal Affairs uses heating oil for various purposes including the fire hall, the pre-heating furnaces for the water system, and the recreation building. The Hudson's Bay store and Co-op store both use heating oil and the three churches do also. In 1982 this sector used approximately 405,000 litres of heating oil while the 1981 volume amounted to about 340,000 litres. Some of the increased use occurred because of the start-up of the water treatment plant in October 1982.

* In all cases hereinafter, total sales have been calculated assuming average distribution losses of 6.5 percent from the total recorded generation output.

Propane use in this sector is limited to a few small users. The volume consumed in 1982 is estimated at 50 percent of that used by the residential sector. The small amount of wood used in the sector has not been included in this analysis.

The transport sector consumed 992,000 litres of gasoline in 1982 compared with 838,000 litres in 1981. Diesel oil sales totalled 1,373,000 litres in 1982. The main user of diesel oil is, of course, Alberta Power Limited (1,171,000 litres), with much of the remainder being consumed by the contractor building the water treatment and distribution system which was completed during 1982. There are a total of 246 registered vehicles in Fort Chipewyan, about half of them passenger vehicles. This sector is not important in the context of the Remote Community Demonstration Program and is included here for information only.

2.3.3 Summary

Total energy consumption in the residential and commercial/institutional sectors in Fort Chipewyan is presented given in Table 2.9. Based on an estimated population of 1,600 in 1982 this amounts to a per capita consumption of 71.3 GJ/yr. Electricity generation was 2,384 kWh/yr while heating oil and propane consumption amounted to 27.8 GJ/yr, both on a per capita basis.

TABLE 2.9

Energy Use in Fort Chipewyan, 1982

Energy Source		Residential Sector	Commercial and Institutional Sector	Total
Electricity	GJ(MWh)*	20,400 (1741)	21,700 (1819)	42,100 (3560)
Heating oil	GJ(m^3)	25,000 (650)	15,600 (405)	40,600 (1055)
Propane	GJ(m^3)	2,600 (100)	1,300 (50)	3,900 (150)
Wood	GJ(cords)	27,400 (2000)	negligible	27,400 (2000)
Total	GJ(%)	75,400 (66%)	38,600 (34%)	114,000

* The values given for MWh represent sales, not generation, i.e. they do not account for the average distribution loss of 6.5% of generation.

2.4 Fox Lake

2.4.1 General Description

This community is located on Indian Reserve No. 162 which is on the south side of the Peace River approximately 150 kilometres east of High Level. The reserve totals approximately 25,793 acres (10,440 hectares) and the population in 1982 was estimated at 750. The community is served by a winter road from Jean d'Or Prairie but access is restricted to air travel at other times of the year. The Band council of the Little Red River Band manages community affairs with assistance from the Department of Indian and Northern Affairs.

The economy of Fox Lake is based on the natural resources available in the area. Hunting, trapping and forestry (mainly fighting fires) provide the main occupations. Members of the Band have been employed in oilfield work and recently the Band was successful in negotiating a contract for clearing land for the Norman Wells to Zama Lake oil pipeline. The Hudson's Bay Company operates a retail store in Fox Lake. The community has a school operated by the Northlands School Division based in Peace River and a federal nursing station. Police service is provided by the RCMP detachment at Fort Vermilion. Fox Lake is about 90 kilometres from the nearest electricity grid and natural gas pipeline, both of which serve Fort Vermilion.

2.4.2 Current Energy Demand and Supply

2.4.2.1 Energy Supply

Alberta Power Limited provides electricity for the community from its diesel generating station. At the end of 1982 there were 74 residential customers and 22 commercial customers, the latter category being overstated by the fact that there are several meters (and therefore several accounts) at the school.

Tables 2.4 to 2.7 show the statistics on electricity generation and fuel consumption for the past five years. The average annual growth in electricity generation for the period was 9 percent. Peak demand during 1982 was 200 kW in March compared with a monthly peak of 80 kW in July. The annual peak in 1978 was 152 kW giving a growth rate over the period of 7.1 percent annually.

Petroleum products are supplied to the community via the winter road. ICG Propane in High Level provides propane for the school, teachers' residences, nursing station and other users while the Hudson's Bay Company obtains its heating oil supply from Fort Vermilion. Because of the limited access, storage tanks are large enough to provide a full year's demand. There are three local suppliers of gasoline who purchase from Fort Vermilion and have about 30,000 litres of total storage capacity. These suppliers also provide small amounts of kerosene which is brought in from Fort Vermilion in 45-gallon barrels.

The primary energy source for most residents is wood which is gathered locally and hauled by pick-up truck, snowmobile, or horse sled. Although sufficient wood is available close to the community, some residents travel up to 40 kilometres to cut dry wood previously killed by fires or floods.

2.4.2.2 Energy Demand

The pattern of energy consumption in the residential sector in Fox Lake is as described in Section 2.2. In 1981, the average electricity consumption by residential customers was 3,235 kWh with the range varying from 575 kWh to 13,400 kWh. In 1982 the average had increased to 3,928 kWh and the 74 residential customers accounted for 291 MWh of the total sales of 727 MWh or a share of 40 percent.

Petroleum products used in the residential sector are limited to the propane used for the teachers' residences* and the nurses' residence plus the heating oil used by the Hudson's Bay Company's two trailers. No estimate is included for the small amounts of propane used for cooking in native homes or for the kerosene used for lighting.

The major users of energy in the community are in the institutional and commercial sector. The school, nursing station, and Band Council office consume propane for water and space heating, while the microwave towers use only electricity. The Hudson's Bay store is the only large user of heating oil.

* The volumes of propane have been estimated based on data from Northlands School Division. Actual data are included in Annex B. There appear to be some errors in the allocation of propane use to the residences and school so that estimates in this section are based on the floor area of each.

No estimate is made for the amount of gasoline and diesel fuel consumed by vehicles. Records are not available, although one seller estimated that he sells about 9,000 litres a month during the winter. There are 34 vehicles registered in Fox Lake of which 12 are passenger vehicles.

2.4.3 Summary

Total energy consumption in Fox Lake during 1982 is presented in Table 2.10, including the sectoral shares. No historical data were available for energy demand except for electricity and two years' data for propane. In 1981 total propane consumption was 256,000 litres compared with 352,000 litres in 1982, primarily because of the severity of the 1982 winter. Based on the population of 750 in 1982, per capita energy consumption amounted to 51.3 GJ while electricity generation was 1,037 kWh per capita.

TABLE 2.10

Energy Use in Fox Lake, 1982

Energy Source		Residential Sector	Commercial and Institutional Sector	Total
Electricity	GJ(MWh)*	5,140 (291)	7,700 (436)	12,840 (727)
Heating oil	GJ(m^3)	230 (6)	300 (8)	530 (14)
Propane	GJ(m^3	3,900 (152)	6,800 (267)	10,700 (419)
Wood	GJ(cords)	14,400 (1050)	negligible	14,400 (1050)
Total	GJ(%)	23,670 (62%)	14,800 (38%)	38,470

* The values given for MWh represent sales, not generation, i.e. they do not account for the average distribution loss of 6.5% of generation.

2.5 Jean d'Or Prairie

2.5.1 General Description

Jean d'Or Prairie is located on Indian Reserve No. 215 on the north side of the Peace River approximately 120 kilometres east of High Level. The reserve totals approximately 34,678 acres (14,030 hectares) and the

population in 1982 was estimated at 650. The 1981 Census data list 70 occupied dwellings with 60 owned by the occupants. The community has year-round access to High Level and Fort Vermilion via Highway 58. The Band council of the Little Red River Band manages community affairs with assistance from the Department of Indian and Northern Affairs.

Main occupations for the residents are farming, hunting, trapping, and forestry. A retail store is maintained by the Hudson's Bay Company. A school is operated by Northlands School Division which has headquarters in Peace River and a nursing station by the Medical Services Branch of Health and Welfare Canada. The Fort Vermilion RCMP detachment provides police service.

The closest electricity grid and natural gas connections are at Fort Vermilion, a distance of about 45 kilometres.

2.5.2 Current Energy Demand and Supply

2.5.2.1 Energy Supply

Electricity for the community is provided from Alberta Power Limited's diesel generating station and at the end of 1982 there were 67 residential customers and 14 commercial accounts; the latter include the school, nursing station, Hudson's Bay Company, Alberta Government Telephones, Canadian Broadcasting Corporation, and various Band Council accounts.

Statistics on power generation for the past five years have been provided by Alberta Power Limited and are presented in Tables 2.4 to 2.7. Average annual growth of electricty generation during the period amounted to 10.7 percent. Peak demand in December 1982 was 163 kW compared with a monthly peak of 115 kW during the summer months. Growth in the peak from 1978 (115 kW) to 1982 amounted to 9.1 percent per year.

Petroleum products (propane, gasoline, heating oil and diesel fuel) for uses other than electricity generation are obtained from retailers in High Level or Fort Vermilion. Some small volumes of gasoline are sold locally by a retailer who purchases in bulk from the outlet in Fort Vermilion. Propane for the school, teachers' residences, and the nursing station is provided by ICG Propane in High Level.

Wood, which is the primary heating and cooking fuel, is obtained locally free of charge and hauled by pick-up truck, snowmobile, or horse sled. There is some commercial trade in wood for those who are unable to obtain it themselves. Sufficient wood is available within short distances of most houses but it is often gathered from as far as 40 km away because of the availability of dry wood (fire or flood killed areas). It is not normal practice to cut green wood and allow it to dry for a season before it is needed and, consequently, many families burn green wood or travel long distances to get dry wood. Predominant species in the region are aspen and black spruce with the latter being the preferred fuel.

2.5.2.2 Energy Demand

Energy consumption in the residential sector follows the pattern described in Section 2.2. In 1981, the average residential customer consumed 3,124 kWh of electricity although the range varied from as low as 600 kWh to as high as 16,400 kWh. In 1982, the average had increased to 3,293 kWh and the 67 residential customers accounted for 221 MWh of the 652 MWh generated that year. Distribution losses account for 6.5 percent of electricity generated, giving total sales of 610 MWh of which 36 percent is attributable to the residential sector. Demand for petroleum products in this sector amounts to the propane used in the teacher's residences* plus the heating oil used by the nurse's residence and the Hudson's Bay store manager's residence. The small amount of propane used for cooking in native homes has not been estimated. Total use in 1982 was estimated to be 58,000 litres of propane and 10,000 litres of heating oil. (Propane use in 1981 was about 46,000 litres). The amount of wood used for heating and cooking is based on an average of 15 cords per year for 60 households.

For the commercial and institutional users, completely disaggregated statistics were not available and these two sectors are combined for this analysis. Propane is used for space and water heating in the school while electricity is used for lighting and for fans, pumps, and blowers. At the new nursing station (completed in January 1983), propane is used for heating whereas the old station used heating oil. The microwave towers use only electricity while Band Council buildings use heating oil and electricity. The Band Council uses include street lighting, water pumping, space heating and water heating as well as some mechanical needs in the workshop.

* The volumes of propane have been estimated based on data from Northlands School Division. Actual data are included in Annex B. There appear to be some errors in the allocation of propane use to the residences and school so that estimates in this section are based on the floor area of each.

The school is by far the largest energy consumer in the community for both electricity and propane. When this is combined with the teacherages, the dominance of Northlands School Division as an energy purchaser becomes even greater. Although no accurate statistics are available, it is apparent that various levels and branches of government consume practically all of the energy used in this sector. These users are the provincial Department of Education (school), federal Health and Welfare (nursing station), and local government (Band Council) which is essentially the federal government through the Department of Indian and Northern Affairs. The same situation exists in the other communities studied.

No estimate of the amount of gasoline and diesel fuel used in the transport sector has been made for reasons stated earlier. There are a total of 48 registered vehicles in Jean d'Or Prairie of which 29 are listed as passenger vehicles.

2.5.3 Summary

Total energy consumption in Jean d'Or Prairie in 1982 is presented in Table 2.11, with the percentages of the total used by each sector also shown. The lack of historical data for all fuels except electricity precludes the calculation of past growth rates in energy use. Using the estimated population of 650 in 1982, per capita generation was 1,003 kWh for electricity and 47.6 GJ consumption for all energy except transport fuels.

TABLE 2.11

Energy Use in Jean d'Or Prairie, 1982

Energy Source		Residential Sector	Commercial and Institutional Sector	Total
Electricity	GJ(MWh)*	3,800 (221)	6,750 (380)	10,330 (601)
Heating oil	GJ(m^3)	380 (10)	1,260 (35)	1,640 (45)
Propane	GJ(m^3)	1,500 (58)	5,200 (204)	6,700 (262)
Wood	GJ(cords)	12,300 (900)	negligible	12,300 (900)
Total	GJ(%)	17,980 (58%)	12,990 (%)	30,970

* The values given for MWh represent sales, not generation, i.e. they do not account for the average distribution loss of 6.5% of generation.

2.6 Trout Lake

2.6.1 General Description

Trout Lake is a Native and Metis community about 30 kilometres south of Peerless Lake. The population is estimated at 203. There are about 40-45 houses. Trout Lake is unincorporated and is part of Improvement District 17 managed from High Prairie. Trout Lake is accessible year-round over a 100 kilometre road through Peerless Lake from Highway 67 at Red Earth Creek. The straight-line distance from Red Earth Creek is about 40 kilometres.

Like the other communities, Trout Lake depends on such primary activities as hunting, trapping, fishing, and forestry. Exploration activities for oil and gas have provided some temporary employment in recent years. The community has a school (Northlands School Division), a general store and community buildings. Under the Rural Home Assistance Program, about 15 homes have been built.

Electricity grid and natural gas connections are 40 kilometres and 140 kilometres away, respectively.

2.6.2 Current Energy Demand and Supply

2.6.2.1 Energy Supply

Alberta Power Limited has a diesel generating plant to provide electricity for the community. At the end of 1982 there were 42 residential and 7 commercial customers. The Slave Lake office of Alberta Power Limited services the plant on a monthly basis with periodic checks performed by a local resident.

Electricity generation and fuel consumption for the past five years are given in Tables 2.5 and 2.6 with other statistics included in Tables 2.4 and 2.7. The high growth rate of 15 percent per year can be attributed to the fact that the plant was first installed in 1978. Not all homes were connected in the first year and, since electricity has become available, residents have purchased appliances such as washing machines, TV's, radios, etc. In addition the new school was opened in 1981 increasing the electricity used. Peak demand for electricity has grown from 37 kW in 1978 to 84 kW in 1982, an average annual growth rate of 22.7 percent.

Petroleum products are supplied to the community from Slave Lake or High Prairie. Large quantities of propane for the school are delivered directly on a year-round basis while small quantities can be purchased at Red Earth where there is a retail outlet. Gasoline is available in Peerless Lake from one retailer who has 45,000 litres storage capacity or in Red Earth which has a retail outlet serving the Slave Lake-Fort Vermilion Highway. The primary residential fuel is wood which is gathered locally and hauled by truck, snowmobile, or horse sled.

2.6.2.2 Energy Demand

Energy use is similar to the other communities with a sharp difference between residential use and use in the school and other facilities. Average residential electricity consumption in 1981 was 2,768 kWh and in 1982 it was 3,516 kWh*. Total residential consumption in 1982 for the 42 customers was 148 MWh or 69 percent of the total sales of 214 MWh. This is the highest share for the residential sector in any of the communities visited. As with other communities, petroleum products (propane and heating oil) are not used in large quantities. The three teachers' residences use propane for heating and cooking although they have electric water heaters**. A few Native families use small quantities of propane for cooking. The estimated amounts of propane used for residential purposes are 27,000 litres. Wood for cooking, space heating, and water heating amounts to about 15 cords (54 cubic metres) per native household per year as discussed earlier. For forty households this totals 600 cords annually (2,170 cubic metres).

In the commercial and institutional sector the major user is the new school which uses electricity and propane. There is a small general store and some small community buildings. Because of the lack of data on other users, the amount of propane used by the school has been increased by 10 percent to arrive at the total for this sector. The electricity consumed by the sector is the 31 percent share not used by the residential customers or a total of 66 MWh.

No estimate is made for the amount of fuel consumed in the transport sector. There are a total of 67 vehicles registered in Trout Lake although this probably includes Peerless Lake also since it has no post office. Thirty-three of the vehicles are passenger vehicles.

* This strong growth can be partially attributed to the colder weather during calendar year 1982.

** Annex B contains data on energy use provided by Northlands School Division. The split for propane use between the school and the residences appears erroneous and an assumption of 9,000 litres per residence was made.

2.6.3 Summary

Table 2.12 shows estimated total energy consumption for 1982. Growth rates of demand for energy other than electricity cannot be calculated because of the lack of data. Propane use in 1981 was 66,400 litres compared with 89,000 litres in 1982. Per capita generation of electricity amounted to 1,123 kWh while total energy consumption was 79.4 GJ per capita. The latter figure appears far too high compared with the values for the communities previously discussed (see Table 2.3), and is partially explained by the low conversion efficiency for the electricity plant (1.47 kWh/litre). If a value of 2.2 kWh/litre were used (value for Jean d'Or Prairie), the per capita consumption would fall to 70.0 GJ per capita which still appears high. The main reason for the apparent inconsistency derives from an unexplained difference in number of registered people per residence which is about 6 in Fort Chipewyan, 10 in Fox Lake and Jean d'Or Prairie and 4 to 5 in the smaller communities of Trout Lake, Peerless Lake and Chipewyan Lake. Since the use of wood, a major source of energy, is related to the number of residences, per capita use of energy is a function of the ratio between population and the number of residences. It is possible that the population is understated. An additional 50 people would bring the 70 GJ down to 56 GJ per capita, still higher than the values for Fox Lake and Jean d'Or Prairie. Because of these uncertainties, the estimates of future demand presented in the next chapter must be viewed with caution.

TABLE 2.12

Energy Use in Trout Lake, 1982

Energy Source		Residential Sector	Commercial and Institutional Sector	Total
Electricity	GJ(MWh)*	3,900 (148)	1,750 (66)	5,650 (214)
Propane	GJ(m^3)	690 (27)	1,580 (62)	2,270 (89)
Wood	GJ(cords)	8 200 (600)	negligible	8,200 (600)
Total	GJ(%)	12,790 (79%)	3,300 (21%)	16,120

* The values given for MWh represent sales, not generation, i.e. they do not account for the average distribution loss of 6.5% of generation.

2.7 Peerless Lake

2.7.1 General Description

Like most of Alberta's remote communities, Peerless Lake's population is mainly Native and Metis. Population was estimated at 204 in 1982 by the Alberta Municipal Affairs Department. The community is located north of Slave Lake about 45 kilometres east of Highway 67 which passes through Red Earth Creek. An unimproved year-round road serves the town from Red Earth Creek (road dis- tance about 80 kilometres). The community is not incorporated and is part of Improvement District 17. It is managed from the Central District Office in High Prairie.

School operation is managed by the Northlands School Division. The Slave Lake RCMP detachment provides police service.

Peerless Lake has been included in the provincial Rural Home Assistance Program and to date about 20 houses have been built.

The closest electricity from the grid is at Red Earth Creek which is 45 kilometres away. Natural gas pipelines serve Slave Lake which is about 150 kilometres distant.

2.7.2 Current Energy Demand and Supply

2.7.2.1 Energy Supply

Peerless Lake receives electricity from Alberta Power Limited's diesel generating station which has two 150 kW units serving 43 residential and 7 commercial customers. The Slave Lake office maintains the plant with a local resident providing periodic checks.

Fuel consumption, electricity generation and other statistics for the past five years are given in Tables 2.4 to 2.7. The growth rate has been quite high at 28.6 percent per year. The strong growth can be partially attributed to the new school which was opened in 1981 and to the purchase of more appliances in the early years of access to electricity. Peak demand for electricity has grown from 33 kW in 1978 to 102 kW in 1982, an average growth rate of 32.6 percent per year. Petroleum product supply to the community is the same as for Trout Lake. Wood is the primary residential fuel and it is gathered locally. Trucks, snowmobiles, and horse sleds are used for hauling.

2.7.2.2 Energy Demand

Demand characteristics are the same as for the other remote communities. For electricity, the average residential sales were 2,768 kWh in 1981. The 1982 average of 3,516 kWh gives total residential consumption of 151 MWh or 46 percent of the total sales of 327 MWh. Petroleum product consumption is limited to the propane used in the teacher's residences plus a small amount for cooking in native homes. This is estimated to total 27,000 litres in 1982. Wood use in the 40 homes averages about 15 cords (54 cubic metres) annually and, therefore, totalled about 600 cords (2170 cubic metres) in 1982.

The new school is the dominant user in the commercial and institutional sector. There are small community administration buildings (e.g. Opportunity Corps, Community Volunteer Corps) which use relatively small quantities of energy. To account for these other users for which data are unavailable, the volume of propane used at the school has been increased by 10 percent. Electricity consumed by the sector is the 54 percent share not consumed by the residential sector or a total of 176 MWh.

2.7.3 Summary

Table 2.13 shows total energy consumption for 1982, excluding the transport sector. Lack of historical data precludes calculation of growth rates for all fuels except electricity. The total per capita energy consumption amounted to 82.4 GJ in 1982 with electricity generation equal to 1,714 kWh per capita. Propane consumption in 1981 was about 58,400 litres compared with 112,000 litres in 1982. The high values for per capita energy consumption compared with the other communities (except Trout Lake) raise similar questions about the data as in the case of Trout Lake. Electrical generation efficiency is not a problem in this community with the 1982 conversion level equaling 2.2 kWh/litre. Population could be understated by 50 which would give a value of 66.0 GJ per capita, still high for a community of this size. The data have been used for the estimates of future consumption but the uncertainty is rather high.

TABLE 2.13

Energy Use in Peerless Lake, 1982

Energy Source		Residential Sector	Commercial and Institutional Sector	Total
Electricity	GJ(MWh)*	2,630 (151)	3,090 (176)	5,720 (327)
Propane	GJ(m^3)	690 (27)	2,200 (85)	2,890 (112)
Wood	GJ(cords)	8,200 (600)	negligible	8,200 (600)
Total	GJ(%)	11,520 (69%)	5,290 (31%)	16,810

* The values given for MWh represent sales, not generation, i.e. they do not account for the average distribution loss of 6.5% of generation.

2.8 Chipewyan Lake

2.8.1 General Description

Chipewyan Lake is probably the most isolated of the remote communities in Alberta. It is 130 kilometres west of Fort McMurray and 110 kilometers north of Wabasca. A winter road provides access from the latter town with air travel the alternative at other times of the year. The population is predominantly Native and Metis and the Alberta Municipal Affairs Department estimates the 1982 population at 150. The community is unincorporated and is part of Improvement District 17 which is managed from Slave Lake.

Chipewyan Lake, like the other communities, is primarily a subsistence town with the population engaged in such activities as fishing, hunting, forest fire fighting, and trapping. Some employment is provided by oil companies exploring in the area with opportunities for work with geophysical and drilling crews. A school is operated by the Northlands School Division while the clinic is operated by the Athabasca Health Unit. Police service is provided from Fort McMurray.

The Alberta Department of Housing and Public Works has been assisting the repair and replacement of houses in Chipewyan Lake for 6 years under the Rural Home Assistance Program. To date about 20 houses have been built using local labour and material as far as possible. A new community hall has been constructed and a fire hall and workshop are under construction.

Chipewyan Lake is 110 kilometres from the closest point on the electricity grid and 200 kilometres from the nearest natural gas service at Slave Lake.

2.8.2 Current Energy Demand and Supply

2.8.2.1 Energy Supply

Alberta Power Limited provides electricity from its diesel generating station and in 1982 there were 35 residential and nine commercial customers. The Fort McMurray office of Alberta Power Limited services the plant monthly with a local resident checking the plant periodically and restarting the plant in case of failure.

Fuel consumption, electricity generation, and other statistics for the past five years are shown in Tables 2.4 to 2.7. The average growth rate has been 15.5 percent per year since plant installation in 1978. Peak demand has grown from 31 kW to 46 kW in 1982, an average growth rate of 10.4 percent annually. Petroleum products are supplied to the community over the winter road from Wabasca with the local general store owner serving as retailer for gasoline and kerosene. Propane for the school and teacherages is provided via the same route. Wood is gathered locally using trucks, snowmobiles, or horse sleds for hauling.

2.8.2.2 Energy demand

Demand characteristics are the same as for other remote communities. In 1982, average residential sales were 2,455 kWh, the lowest for all of the isolated communities served by Alberta Power Limited. This gives total consumption by the 35 customers of 86 MWh or 52 percent of the total sales of 166 MWh.

Residential consumption of petroleum products amounted to about 15,300 litres of propane and 2,500 litres of kerosene. Kerosene is used for lamps and for starting fires. Wood use in 32 homes would amount to a total of 480 cords (1,740 cubic metres) assuming 15 cords per home per year.

The school is the primary user in the commercial and institutional sector with other users such as the community hall, the health clinic, and Alberta Government Telephones using smaller quantities. The estimated amount of propane used is based on the use by the school plus 10 percent. Electricity consumed by this sector amounts to the difference between total sales and residential sales or a total of 80 MWh. There is some wood used in heating community buildings including the church but these small volumes have not been estimated.

2.8.3 Summary

Total energy consumption for 1982, excluding the transport sector, is shown in Table 2.14, along with a sectoral breakdown. Historical data for fuels other than electricity are not available. The per capita energy consumption in 1982 amounted to 68.4 GJ with electricity generation at 1,184 kWh per capita.

TABLE 2.14

Energy Use in Chipewyan Lake, 1982

Energy Source		Residential Sector	Commercial and Institutional Sector	Total
Electricity	GJ(MWh)*	1,300 (86)	1,220 (80)	2,520 (166)
Heating oil	GJ(m^3)	90 (2.5)	negligible	90 (2.5)
Propane	GJ(m^3)	400 (15.3)	650 (25.2)	1,050 (40.5)
Wood	GJ(cords)	6,600 (480)	negligible	6,600 (480)
Total	GJ(%)	8,390 (82%)	1,870 (18%)	10,260

* The values given for MWh represent sales, not generation, i.e. they do not account for the average distribution loss of 6.5% of generation.

2.9 Peace Point

2.9.1 General Description

This community is located within Wood Buffalo National Park on an all-weather service road. It is a relatively new community, established by members of the Cree Band from Fort Chipewyan. In 1982, the population amounted to 65. There is a school and the Band runs a small diesel plant. Alberta Power Limited is planning on installing a diesel generating plant during 1983.

Peace Point is about 80 kilometres northwest of Fort Chipewyan.

2.9.2 Current Energy Demand and Supply

2.9.2.1 Energy Supply

The energy supplied to this new and growing community is limited at present. The Band owns a small diesel generating plant which is to be replaced by an Alberta Power Limited plant (two 40 kW units) during 1983. Fuel storage capacity will be 45,000 litres. The existing plant provides electricity for the school, two teachers' residences, and a limited amount for the residents. No data are available on electricity generated or fuel consumed.

Heating oil is supplied from Fort Smith for the school and the teacher's residences, with wood gathered locally supplying the remaining energy needs.

2.9.2.2 Energy Demand

Data are not available for energy use in this community so estimates have been made based on the number of houses, the size of the school, and energy use in other communities. Table 2.15 presents these estimates. No breakdown by sector is given. Based on a population of 65, per capita use amounts to 33.8 GJ and 538 kWh.

TABLE 2.15

Estimated Energy Use in Peace Point, 1982

Energy Source	Physical Units	Gigajoules
Electricity	35 MWh	500
Heating oil	8 m^3	300
Wood	100 cords	1,400
Total		2,200

2.10 Other Communities

The following communities were considered as candidates for this program but only Garden Creek meets the criteria listed in Chapter 1. It was not visited because of its similarity to the other communities. The other communites were eliminated for the reasons stated below.

Garden Creek

Garden Creek is a Native community located at the confluence of Garden Creek and Peace River just inside the western boundary of Wood Buffalo National Park. The population is about 150 and is fairly stable. This is the third community of the Little Red River Band and the same Council manages community affairs. For the purpose of this report, information regarding the community was obtained from the Band Council and energy conditions and opportunities were inferred from conditions and opportunities in comparable communities. The community has a school operated by the Northlands School Division and a health clinic which is visited periodically by the nurse stationed at Jean d'Or Prairie.

Garden Creek is accessible from Jean d'Or Prairie by a year-round logging road which is open except for freeze-up and break-up periods. There is a logging operation near the community within the National Park which is providing logs for the mill at High Level.

Currently, a Band-owned generator provides electricity for the schoo' and clinic but Alberta Power Limited is planning to install a larger generator this year to service the whole community. A new school is also planned for Garden Creek.

Garden Creek is about 80 kilometres east of Jean d'Or Prairie and 200 kilometers east of High Level.

Steen River

This community, located on the Mackenzie highway about 140 km north of High Level, is primarily a highway maintenance centre. Although Alberta Power Limited is planning to install a diesel generator during 1983, there are less than ten permanent dwellings and the community does not qualify for this program.

Fitzgerald

This community consists of two or three families and in recent years the population has fallen. It is located on the Slave River 20 km south of Fort Smith, Northwest Territories. The community is too small for inclusion in this program.

Carcajou

Because the residents of this area are spread out over a fairly large area, mainly on farms, it is not considered a community by Alberta Municipal Affairs. It has, therefore, been excluded from further consideration.

Small Boy Camp

This Native community has been established south of Edson in western Alberta. A Band-owned generator provides electricity for the school but the residents are scattered over a fairly large area and have no electric service. Because there is no well-defined community, it was not considered for further study. This situation may change in the future if the residents start building houses in one central area, around the school for example, where electricity and other services may be available.

2.11 Energy Prices

Most fuels are priced higher in these communities than in less remote areas because of the transportation costs. Prices for electricity have changed recently as a result of the creation of the Electric Energy Marketing Agency which will attempt to equalize tariffs throughout the Province. The tariff calculation procedure is described later in this section.

Petroleum product prices vary among the locations visited. The following range is representative:

TABLE 2.16

Prices of Petroleum Products, 1983

Product	Remote Communities cents/litre	Edmonton Bulk Price cents/litre
Gasoline*	44 - 55 (retail)	36.0
Diesel oil	31 - 36 (bulk)	31.3
Heating Oil	33 - 35 (bulk)	29.0
Propane	19 - 22 (bulk)	16.5

* The Bulk Price for regular gasoline at Fort Chipewyan is 39.25 cents/litre.

Sources: Gulf Canada, Alberta Power Limited, ICG Propane.

The prices which Alberta Power Limited and other major users such as the schools pay are generally at the low end of the range. Depending on location, Alberta Power Limited pays between 31 cents and 34 cents per litre for diesel fuel.

Wood is sold in all of the communities although most families gather their own. Prices vary significantly and the volumes sold are not generally measured. Wood is sold by the cord in some communities and in others by the "rick". Depending on the community there are two or three ricks per cord. The prices quoted gave an effective range of $50 - $100 per cord delivered, sawn in stove-lengths but not split.

Electricity tariffs charged by Alberta Power Limited in the isolated communities are calculated according to Rate Schedule 13 for residential customers and Rate Schedule 23 for commercial and institutional customers. These schedules are included in Annex C along with Rider A-2 and Rider F which refer to surcharges and adjustments. For residential customers the following summary describes the tariff:

a) There is a monthly charge of $8.57,

b) Energy charges are as follows for any monthly period:

0 - 200 kWh	11.06 cents/kWh
201 - 500 kWh	8.94 cents/kWh
over 500 kWh	5.93 cents/kWh plus surcharge of 9.05 cents/kWh

c) The current discount according to the Electric Energy Marketing Agency regulations is 30% subtracted from the total of the above charges.

d) The Provincial discount of 5% is subtracted.

e) A franchise or municipal tax is added.

For details of the tariff see Schedule 13 in Annex C.

For commercial and institutional customers, the monthly charge is calculated as follows:

a) A demand charge is calculated at $3.52 per kW.

b) Energy charges are calculated as follows:

For the first 200 kWh per kW of billing demand	10.03 cents/kWh
For the next 200 kWh per kW of billing demand	6.95 cents/kWh
For energy in excess of 400 kWh per kW of billing demand	5.62 cents/kWh

c) A surcharge of 9.05 cents/kWh is charged for all energy used over 500 kWh in any monthly period.

d) The discounts and tax described for residential customers are applied to the total charges.

The average annual consumption by residential custome in ewyan was 6,039 kWh in 1981 and 6,498 kWh in 1982 indicating th in the winter, monthly consumption would generally be less tha These customers would not incur the surcharge of 9.05 cents/kWh a in effect, be subsidized by most commercial/institutional cus would pay this charge in almost all months. In the other isolate ities the average residential consumption has been significantly in Fort Chipewyan.

Electricity tariffs have increased at the same rate as (consumer price index for Alberta) over the past ten years i Power Limited's service area and are expected to rise at the same the future, i.e., no real increases in price are projected. It s noted that in 1982 action by the Alberta Electric Energy Marketin resulted in a decrease of about 25 percent in the electricity ta isolated communities.

Petroleum product prices have been forecast by EMR and incl the NEP Update 82 publication entitled "Supplementary Inform Canadian Energy Supply/Demand Outlook, 1981 - 2000", June 1982 (Re For Alberta, prices are forecast to increase at a real rate of 3.3 per year from 1982 to 1990 and at a rate of 2.6 percent per year fr to 2000. These growth rates have been used in the analysis of tives in Chapter 5. The impact of these expected price i consumption has not been estimated because it is likely to pared with the effects of other factors such as appliance purchas running water service.

CHAPTER 3

FUTURE ENERGY DEMAND, 1985 AND 1990

3.1 Introduction

This section presents the future estimated demands for energy in each of the communities considering only the residential, commercial and institutional sectors. The data base for the estimates is very poor and it was necessary to make several assumptions regarding existing and future use. The basic assumptions used in calculating future demand for the communities are as follows:

a) Population for each community will grow at 3 percent per year as estimated by various government agencies (Peace Point is an exception and is discussed later).

b) Where possible the average use of heating fuel for 1981 and 1982 is used as a base to remove the effects of weather.

c) The past growth in electricity use is modified to account for expected changes such as the use of electric water heaters or the construction of new schools. Current average residential consumption is low enough to permit growth rates in excess of population growth.

d) The replacement of older housing is expected to reduce average household use of wood but population increases will result in total wood consumption remaining about constant.

e) The use of heating oil or propane will increase as water and sewer services are installed in the communities and overnight freeze protection is required.

f) Price increases will have little effect on consumption.

g) The economy of the communities will not change much during this decade although incomes may increase with more activity in oil and gas exploration near some of the communities.

3.2 Summary of Potential Energy Demand for Eight Isolated Communities, 1985 and 1990

The tables presented in this section show the projections for the eight communities in physical terms and energy content. Also included is an estimate of the total demand for oil-based products in 1985 and 1990, excluding fuel used for transport. This provides an estimate of the maximum potential for substitution using other fuels.

Total population in the eight communities will be about 4,100 in 1985 and 4,750 in 1990 giving average per capita energy consumption levels of 70 GJ and 77 GJ in those years. This level of consumption is well below the provincial average of 335 GJ per capita in 1978. The projections shown in Tables 3.1 and 3.2 are used in Chapter 5 where alternative sources of energy are considered.

As noted earlier in the report, the data base for energy use in these communities is not well defined. When this is combined with the uncertainty inherent in the assumptions, it is apparent that the projections for future use presented in Tables 3.1 and 3.2 can only be taken as representative. It is possible to generate several different projections using different assumptions but these would be neither more nor less reliable than those used here. The important points to note in the projections are the probable continued reliance on diesel for electricity generation and the potential for increased use of heating oil in homes which currently use only wood as a fuel.

Table 3.3 shows the changing pattern of energy use in the communities. Electricity and heating oil will increase in importance as fuel sources if the assumptions made in this study are valid. The assumptions are based on increasing standards of living in the communities and the results indicate that such a goal can only be accomplished with increased use of energy. While the numbers may not be accurate for reasons stated earlier, they do exhibit the trend which is likely to occur over the next few years.

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TABLE - 3-1

PROJECTED DEMAND FOR ENERGY IN 1985

Community	Electricity* GJ (MWh)	Propane GJ (m3)	Heating Oil GJ (m3)	Wood GJ (cords)	TOTAL
Fort Chipewyan	68,000(5,740)	3,600 (140)	53,800(1,400)	27,400(2,000)	152,800
Fox Lake	16,000(1,000)	7,800 (304)	540 (14)	14,400(1,050)	38,740
Jean d'Or Prairie	13,700 (870)	6,740 (263)	1,350 (35)	12,300 (900)	34,090
Trout Lake	7,200 (305)	2,440 (95)	380 (10)	8,500 (620)	18,520
Peerless Lake	7,600 (410)	2,800 (110)	380 (10)	8,500 (620)	19,280
Chipewyan Lake	4,000 (290)	1,250 (49)	380 (10)	6,700 (490)	12,330
Peace Pt.	1,200 (85)	- -	620 (16)	2,200 (160)	4,020
Garden Creek	2,900 (180)	1,400 (55)	190 (5)	3,100 (230)	7,590
TOTAL	120,600(8,880)	26,030(1,016)	57,640(1,500)	83,100(6,070)	287,320

* The energy required for electricity generation is based on the average conversion efficiency for 1981 and 1982 at each plant. Distribution losses of 6.5% are assumed.

TABLE - 3-2

PROJECTED DEMAND FOR ENERGY IN 1990

Community	Electricity* GJ (MWh)	Propane GJ (m3)	Heating Oil GJ (m3)	Wood GJ (cords)	TOTAL
Fort Chipewyan	91,000 (7,690)	3,600 (140)	69,000(1,790)	27,400(2,000)	191,000
Fox Lake	25,000 (1,550)	7,800 (304)	2,500 (64)	14,400(1,050)	49,700
Jean d'Or Prairie	22,000 (1,400)	6,740 (263)	1,640 (45)	12,300 (900)	42,680
Trout Lake	11,500 (490)	2,440 (95)	3,100 (80)	8,200 (600)	25,240
Peerless Lake	9,400 (510)	2,800 (110)	3,100 (80)	8,200 (600)	23,500
Chipewyan Lake	6,500 (460)	1,250 (49)	2,300 (60)	6,600 (480)	16,650
Peace Pt.	2,100 (140)	- -	620 (16)	2,740 (200)	5,460
Garden Creek	4,500 (285)	1,400 (55)	400 (10)	3,500 (250)	9,800
TOTAL	172,000(12,525)	26,030(1,016)	82,660(2,145)	83,340(6,080)	364,030

* The energy required for electricity generation is based on the average conversion efficiency for 1981 and 1982 at each plant. Distribution losses of 6.5% are assumed.

TABLE 3.3

Summary of Estimated Energy Consumption by Source for Eight Communities

Year	Electricity		Propane*		Heating Oil		Wood		Total
	GJ	%	GJ	%	GJ	%	GJ	%	GJ
1982	79,660	35	27,500	12	43,300	19	78,500	34	228,960
1985	120,600	42	26,030	9	57,640	20	83,100	29	287,320
1990	172,000	47	26,030	7	82,660	23	83,340	23	364,030

* The propane use drops from the 1982 level because the base used was the average of 1981 and 1982 to remove the effects of the harsh winter in 1982.

From Table 3.4 it can be seen that about 60 percent of the projected consumption of non-renewable energy products consists of diesel oil for the generation of electric power. Fort Chipewyan accounts for nearly 60 percent of the total diesel oil requirements for electric power generation. Total power generated in the eight communities would be 9 GWh in 1985 and 12.5 GWh in 1990.

TABLE 3.4

Estimated future demand for non-renewable energy products in eight isolated communities (excluding transport)

	1985		1990	
	m^3	Gigajoules	m^3	Gigajoules
Diesel oil for electric power	3,300	120,600	4,100	172,000
Heating oil	1,500	57,640	2,135	82,660
Propane	1,016	26,030	1,016	26,030
Totals		204,270		280,690

Heating oil accounts for about 30 percent of demand for these products. Most of the projected consumption, 95 percent in 1985 and 84 percent in 1990, is in Fort Chipewyan. In relative terms, demand for this product is expected to grow rapidly in the other seven communities and, as shown in Table 3.3, its relative importance in energy supply is likely to increase in the future.

Only 15 percent of the propane consumption is located in Fort Chipewyan and consumption of this product is expected to remain virtually constant. Substitution of propane is not considered to be important in Alberta where supply is based on natural gas production.

3.3 Fort Chipewyan

The economy of Fort Chipewyan is unlikely to change much in the next few years with trapping, fishing, and forestry, including fighting fires, being the main occupations. As a consequence incomes are not likely to change significantly. This analysis does not allow for any major events such as construction of a hydroelectric power station on the Slave River. The impact such a project would have on Fort Chipewyan would probably not be great since most work would be in the Fort Smith region about 150 kilometres away. In addition, the impact would be temporary rather than permanent since most of the available jobs would be in construction of the dam, powerhouse, and transmission line.

Fort Chipewyan residents recently received the service of a water system serving the whole community although all houses have not yet been connected. It is expected that this process will take between one and two years. This service will have a positive effect on the growth rate for energy use for two reasons. First, there will be the need for 24-hour heating of homes for freeze protection. Many families now let their wood fires go out overnight and in these homes it will be necessary to provide some other heating source, most likely an oil space heater. These would be supplementary units but they would probably be used more over time as families become used to the convenience of oil heat compared with gathering wood. (It is important to note that for those families receiving social assistance the amount of fuel used is not dependent on income since the welfare agency will pay utility and fuel bills if receipts are shown).

Another option for overnight heating would be more-efficient wood stoves to replace existing stoves. Such stoves are not common at present and their introduction would require some publicity. Second, families will probably purchase electric water heaters after they are connected to the water system. It is assumed that all homes with water service will have water heaters within three years. In Fort Chipewyan and the other communities, appliances tend to be purchased on a cash basis after the forest fire season and it is likely that there will be enough income from this source to justify the above assumption. An additional increase in energy demand will occur as the volume of water consumed increases. This will be in the form of electricity for pumping and oil for pre-heating the water.

New houses in Fort Chipewyan are likely to be more energy efficient than existing houses but the impact on overall energy use will not be great. Of the 268 houses in Fort Chipewyan probably 40 percent need replacing but it is unlikely this will happen soon unless a concerted effort is made. There are jurisdictional problems related to land ownership and these must be resolved before housing is improved or replaced. Many of the dwellings needing to be replaced are trailers which are not well suited for the climate and most of them use wood as the primary fuel.

The demand for energy in most of the commercial and institutional sector will probably grow at about the same rate as the population. Most of the basic services are in fairly new buildings such as the post office, health clinic, senior citizens home and the RCMP. A new school will be built to replace the existing temporary buildings and energy demand there will undoubtedly increase. The new school has not yet been designed but it will be bigger and will have more facilities than the current structure. A new fire hall is being built and will require heating. As noted above, the water system will also increase the demand for energy.

The following assumptions are made for the energy demand projections:

a) To account for the expected increase in ownership of electric water heaters, it is assumed that the growth in electricity consumption from 1982 to 1985 will be the same as from 1979 to 1982 (14.6 percent per year). From 1985 to 1990 growth is assumed to drop to 6 percent per year.

b) For heating oil, the base is taken as the average of 1981 and 1982 consumption which equals 920,000 litres. For the reasons stated earlier (more space heaters, new school) growth in demand will be strong in the next three years. A growth rate of 15 percent per year is assumed until 1985 with a rate of 5 percent after 1985.

c) It is assumed that propane use will not increase during the forecast period. The average of 1981 and 1982 consumption is used.

d) The use of wood is assumed to remain constant over the period.

The demands for the various forms of energy in 1985 and 1990 resulting from these assumptions are shown in Tables 3.1 and 3.2. Per capita energy consumption would be 89.6 GJ and 96.6 GJ in 1985 and 1990, respectively.

3.4 Jean d'Or Prairie

With the increased income from projects such as pipeline right-of-way clearing, the Indian Band is intending to improve living conditions on both reserves (Jean d'Or Prairie and Fox Lake) and at Garden Creek. One of the projects under study is a water and sewer system and the Band hopes to install it in the next five years. Repair and replacement of housing is also under consideration.

In the institutional and commercial sector, a new nursing station was opened in January 1983 and a workshop/garage is under construction. A new nurses' residence will be built to replace the trailer currently used. No other facilities are planned for the next five years.

The following assumptions are made regarding future energy use:

a) The use of electricity will continue to grow at a faster rate than population. An overall rate of 10 percent per year is assumed for the period to 1990. This rate should also be sufficient to allow for electric water heaters. The additional use in the new nursing station is not considered explicitly.

b) Petroleum product consumption will change. In addition to the base (average of 1981 and 1982) propane use at the school and teacher's residences, the nursing station will use propane instead of heating oil and by 1985 the new nurse's residence should be constructed and it too will use propane. Consumption at the station is estimated to be about 17,000 litres per year and about 10,000 litres for the residence. Assuming that indoor plumbing is introduced to some homes commencing in 1985, heating oil use will increase. We assume a reduction in use of 10,000 litres from 1982 to 1985 because of the fuel switching at the nursing station and a growth of 5 percent per year after 1985.

The estimates shown in Tables 3.1 and 3.2 indicate that total energy use could grow at 3.3 percent per year from 1982 to 1985 and at 4.6 percent per year for the following five-year period. Based on a population of 710 in 1985 and 820 in 1990, the per capita energy consumption would be 48.0 GJ in 1985 and 52.0 GJ in 1990.

3.5 Fox Lake

The only current building project in Fox Lake is a new workshop/garage which is under construction and there are plans to build 10 new houses. The Band Council is investigating the possibility of building an all-weather road to Fox Lake with a ferry and ice road crossing of the Peace River. This would have little impact on the use of energy within the community for any sector except transport although prices for petroleum products may be reduced. The development which would have the greatest impact on energy use in the community is the installation of water and sewer systems, a project which the Band Council views as a priority for improving living conditions. There are, however, no definite plans.

Having regard for the fact that the only probable changes in the community are population growth, some income growth with diversification as the Band Council's plans materialize, and possible installation of a water and sewer system, the following assumptions are made:

a) Electricity demand will continue to grow at the same rate as from 1978 to 1982 (9.0 percent) due to population and income growth.

b) Heating oil use will begin to grow after 1985 to account for supplemental space heating needs with indoor plumbing systems. It is assumed that demand will grow by 10,000 litres per year.

c) Propane use will remain at the average of 1981 and 1982.

d) Wood use will remain constant for reasons discussed earlier.

If energy consumption grows according to these estimates, growth in total energy demand amounts to less than one percent per year from 1982 to 1985 primarily because of the cold winter in 1982 when energy use was higher than the base for the forecast. Growth would be 5.1 percent per year from 1985 to 1990. The per capita energy consumptions would be 47.2 GJ and 52.3 GJ in 1985 and 1990, respectively. The per capita electricity consumption would reach 1630 kWh in 1990, up from 970 kWh in 1982. The projections are shown in Tables 3.1 and 3.2.

3.6 Trout Lake

The community is building a fire hall which would require heating on a continuous basis, probably using propane, but there are no other planned community facilities. A health clinic is being considered jointly with Peerless Lake but no decision has been made.

In the residential sector, the new home program of Alberta Housing and Public Works will continue with more houses each year than needed for population growth. These houses are efficient in their use of energy, requiring an estimated five cords of wood per year compared with the average of 15 cords. The houses currently being built have roughed-in plumbing in preparation for water and sewer service which the provincial government is planning to install within five years. As for the other communities, this is expected to increase electricity use for water heating and will require supplemental space heating. The most likely source for heating would be oil-fired space heaters because of their convenience.

The following assumptions are made regarding future energy consumption*:

a) The growth rate for electricity consumption has been quite high over the past five years, amounting to 15 percent per year, partially because of the opening of the new school. The rather low average household use still leaves room for significant growth but growth in the commercial/institutional sector is not likely to be as high. A lower growth rate of 10 percent per year is assumed for the period to 1990.

b) Petroleum product use is currently limited to propane. The fire hall will require propane and some homes will probably begin to use heating oil for space heating. It is assumed that propane use will increase from the average of the 1981 and 1982 levels by 20,000 litres by 1985 and remain constant until 1990. Barring some action to avoid the use of heating oil, it is assumed that by 1990, forty homes will be using 2000 litres of heating oil each as supplementary fuel. By 1985, it is assumed that use of heating oil is 10,000 litres.

* As noted in Chapter 2, the per capita use in Trout Lake in 1982 appears to be too high. This may be because of erroneous data or because of under-estimated population. The 1982 base is used for these projections, however, and the reader should keep these uncertainties in mind.

c) It is assumed that average household consumption of wood will drop to 14 cords and 12 cords by 1985 and 1990, respectively. The number of houses using wood as a primary fuel will reach 44 in 1985 and 40 in 1990.

The growth in total energy demand according to these estimates is 4.7 percent per year from 1982 to 1985 and 6.4 percent per year for the second half of the decade. Per capita energy consumption would be 83 GJ in 1985 and 98 GJ in 1990. Electricity consumption would reach 1,907 kWh per capita in 1990 up from 1,100 kWh in 1982. The projections are shown in Tables 3.1 and 3.2.

3.7 Peerless Lake

This community is very similar to Trout Lake and Alberta Municipal Affairs has essentially the same plans for both communities. The Rural Home Assistance Program will continue in the community along with the plans for water and sewer service within five years. The effects on energy consumption will be the same as in Trout Lake.

The following assumptions are made regarding future energy demand*:

a) The growth rate for electricity consumption will fall from the very high rate of 28.6 percent per year. It is assumed that this was caused primarily by the new school and that growth in the near future will only come from an increase in residential use. A growth rate of 5 percent is selected.

b) Propane use will increase by 20,000 litres by 1985 (using a base of 90,000 litres) and remain constant thereafter. Heating oil use will be 10,000 litres by 1985 unless action is taken to use some other energy source. By 1990 it is assumed that forty houses would be using a total of 80,000 litres of heating oil.

* The same situation exists for this community as for Trout Lake: the high per capita energy consumption may be caused by erroneous consumption data or by a low population estimate. The projections, therefore, include a greater uncertainty than for the other communities where the per capita consumption figures fall in a smaller range of values.

c) Average wood consumption is assumed to drop to 14 cords per house in 1985 for 44 houses and to 12 cords per house in 1990 for 50 houses.

The energy demands resulting from these assumptions are shown in Tables 3.1 and 3.2. The estimates result in a growth rate for total energy demand of 4.7 percent per year from 1982 to 1985 and 4.0 percent per year from 1985 to 1990. Per capita energy consumption would be 86.4 GJ in 1985 and 91.0 GJ in 1990. Electricity consumption would grow to 1,840 kWh per capita in 1985 and 1,980 kWh per capita in 1990.

3.8 Chipewyan Lake

Chipewyan Lake is very similar to Trout Lake and Peerless Lake although it is a little more isolated and the lifestyle reflects that isolation. For example, the average residential consumption of electricity is lower in Chipewyan Lake than in the other communities, 2,016 kWh in 1981 compared with 2,768 kWh for Trout Lake and Peerless Lake. In 1982, it was 2,455 kWh per household in Chipewyan Lake compared with 3,516 kWh in the other two communities.

The economy is based on the same primary activities and, increasingly, on employment with companies developing the gas field which underlies a large area surrounding Chipewyan Lake. Increasing incomes are creating a demand for more small appliances and the general store operator has received his first order for an electric stove. Such purchases will probably increase in the future and the average household electricity consumption will approach that of the other communities.

The school at Chipewyan Lake is scheduled for replacement and this will cause an increase in demand for electricity and propane similar to the increases experienced in Trout Lake and Peerless Lake. The Rural Home Assistance Program is continuing and, as with the other comunities, the new homes are energy efficient and have roughed-in plumbing in preparation for this service within five years.

Because Chipewyan Lake is in the middle of a gas field which produces sweet, dry, low pressure natural gas, it is possible that this source could be used for electricity generation, space heating at the school, and space heating in homes instead of using heating oil for freeze protection. Such a situation would probably require specific action from outside the community.

The following assumptions are made regarding future energy demand in Chipewyan Lake:

a) The new school will be built before 1985 and will cause a sharp increase in electricity and propane use. It is assumed that electricity growth will amount to 18 percent per year until 1985 and will drop to 10 percent for 1985 to 1990.

b) The use of propane at the school will increase by 50 percent by 1985 (using the 1981-82 average). Energy use at the school will remain constant thereafter. Other propane use will remain constant.

c) The average household use of wood will decline to 14 cords in 1985 and 12 cords in 1990. There will be 35 houses in 1985 and 40 in 1990 using wood as the main fuel.

d) Heating oil will be used for freeze protection. Consumption will reach 10,000 litres in 1985 and 60,000 litres in 1990.

The estimates shown in Tables 3.1 and 3.2, result in a growth rate for total energy consumption of 6.3 percent per year to 1985 and 6.2 percent per year from 1985 to 1990. Per capita energy consumption would grow to 75.2 GJ and 87.6 GJ in 1985 and 1990, respectively. Electricity consumption, based on sales, would amount to 1640 kWh per capita and 2,260 kWh per capita for the same two years.

3.9 Peace Point

There is no data base for projecting energy use in Peace Point and, with the installation of Alberta Power's generating plant to replace the small Band-owned plant, energy use patterns are likely to change over the next few years. Indian and Northern Affairs projects population growth at 3 percent per year from the current level of 65. However, the Cree Band at Fort Chipewyan, to which the residents belong, sees more growth in early years as families move from Fort Chipewyan. For this study it is assumed that the population will reach 80 by 1985 and 100 by 1990. With 80 residents there will be about 15 households and about 20 households in 1990.

Indian and Northern Affairs has provided details of the floor areas of existing facilities in Peace Point (classroom, teacher's residences and a drop-in centre). Assuming that another teacher's residence and classroom are added, the total floor area would amount to about 400 square metres. It is estimated that consumption of heating oil would rise to 16,000 litres annually.

For electricity demand, it is assumed that average household demand will be 2,500 kWh in 1985 and 3,200 kWh in 1990. These values are based on those observed at Chipewyan Lake and Trout Lake. It is assumed that the demand at the school and other facilities such as the drop-in centre and garage will equal the residential demand.

Wood demand will be lower on average than in Fort Chipewyan and other communities because the new houses are built with reduced consumption in mind. Assuming an average of 10 cords per year, consumption will be 160 cords in 1985 and 200 cords in 1990. There are no plans for a water system at Peace Point.

3.10 Garden Creek

Demand for energy in Garden Creek is estimated based on demand in Jean d'Or Prairie and Fox Lake. Alberta Power is planning to install a diesel generating plant in 1983 and a new school is planned for the community. Based on growth of 3 percent per year from 150 in 1982, population would be 165 in 1985 and 190 in 1990. There would, therefore, be about 17 and 19 houses in 1985 and 1990, respectively, if the same ratio is used as in the other two communities. We assume that energy use in Garden Creek will be 90 percent of the per capita level in the other two communities for two reasons:

a) electricity use is lower in the early years of service, and

b) the new school will probably be more energy efficient than those in the other communities.

The estimates are shown in Tables 3.1 and 3.2. Per capita energy consumption amounts to 46.3 GJ in 1985 and 51.6 GJ in 1990.

CHAPTER 4

ENERGY RESOURCES NEAR THE REMOTE COMMUNITIES

This section presents a description and a brief qualitative assessment of the energy resources which could possibly be exploited to meet the needs of the remote communities. No original field work has been performed for this study and no conclusions are drawn in this Chapter regarding the feasibility of using the resources. Possibilities for using local energy resources are considered in the preliminary analyses in Chapter 5. Rather than discuss each community separately, this section is arranged by resource.

4.1 Petroleum (crude) and Natural Gas

To date the only community which has either of these resources nearby is Chipewyan Lake which is in the middle of a large gas field. The gas is at shallow depth and it is sweet, dry and at low pressure. The field is being brought into production and the possibility exists for using this resource to replace the diesel oil used for electricity generation and the propane used for heating the school and teachers' residences. A preliminary analysis of the cost of such a project is included in Chapter 5.

Geophysical exploration and drilling is currently undertaken in the area around Trout Lake and Peerless Lake. The Red Earth oil field lies about 60 kilometres to the west while the Liege gas field (Chipewyan Lake) lies to the east and a smaller gas field is located about 25 km north of Peerless Lake. The probability of discovering gas is relatively high and it should be considered as a possible resource to be used for community needs in the future. If oil were discovered it is not likely that it would be used to substitute for existing fuels. Local demand is too small to warrant processing the crude oil and the oil would need to be of high quality to displace diesel fuel directly. However, there is the possibility that gas produced in association with any oil discovered could be used in the communities.

Jean d'Or Prairie and Fox Lake are east of the area near High Level which is undergoing fairly intensive exploration at present. However, little activity has occurred around the two communities and prospects are considered less attractive. Fort Chipewyan is situated on Pre-Cambrian Shield bedrock and has no possibility of hydrocarbon discoveries. Peace Point is located within Wood Buffalo National Park where exploration is not permitted but, in any case, the sedimentary section is too thin to be of interest.

4.2 Hydropower

There has been no detailed survey of streams near the communities to determine whether there are any possibilities for small hydropower stations. Topography is generally quite flat in this part of the province with streams and rivers draining large areas but with small gradients. Additionally, most of the small streams freeze completely during the winter which is also the season with the greatest demand for electricity.

One site on the Peace River between Jean d'Or Prairie and Fox Lake has been identified as having a large theoretical hydropower potential. The Vermilion Falls site has the potential to produce 1170 GWh per year but no investigations into the technical or financial viability of such a project have been performed. The possibility of diverting a small portion of the river flow to meet the needs of the communities has not been addressed. However, a preliminary estimate of the investment which could be justified for such a project is included in Chapter 5.

Fort Chipewyan lies 150 kilometres from the rapids on the Slave River which have been identified as a feasible site for a hydropower project. The transmission lines carrying electricity from such a project could pass near Fort Chipewyan and it would be possible to service the community from this source. The project has not yet been submitted to regulatory agencies for approval and it is unlikely that power would be available within ten years.

4.3 Peat and Coal

Coal has not yet been identified near any of the communities being studied. Peat, on the other hand, can be found near most of the communities. The muskeg swamps of northern Alberta contain peat of varying quality as measured by the degree of decomposition of the vegetable matter from which it originated. No detailed surveys of actual quantities and quality of peat from specific bogs have been performed but an internal study by Energy, Mines and Resources' Western Regional Office has identified potential resources in the vicinity of Fox Lake and Jean d'Or Prairie. Other bogs occurring in areas with similar terrain and vegetation can be found near the other communities.

The EMR study concluded that the potential demand for peat as a heating fuel in the communities was too small to warrant further work and that the minimum-sized peat-fired electricity plant (8 MW) was too large and, at $13 million, too expensive to be considered. The Saskatchewan government

is conducting a peat fuel utilization demonstration project in north-central Saskatchewan and estimates the variable costs for a 4,000 tonne/year operation to be $38.60 per tonne. Capital costs would amount to nearly $350,000 adding about $8 per tonne. It would be practically impossible for fuel at this cost to compete with wood which is generally obtained free-of-charge if labour costs are ignored. There are, of course, hidden costs in gathering wood, such as the gasoline for trucks and chainsaws, which should be considered when assessing other fuels but no accurate estimates are available for these costs.

The peat resources near the remote communities do not appear to be useful at present but the results of the Saskatchewan demonstration project should be monitored. If production appears to be economic and if markets are identified, the resources around the remote communities could be harvested for commercial purposes.

4.4 Wood

The remote communities are generally located in aspen (poplar) and black spruce forests with smaller quantities of jackpine. Peace Point is in an area of primarily spruce and pine. The communities have not reached the point where wood is unavailable within reasonable distances (less than 10 kilometres) although some residents choose to travel distances upwards of 40 km to harvest trees which have been fire or flood killed.

The screening study of wood gasification for Indian and Northern Affairs performed by Crippen Consultants (Ref. no. 3) included maps showing the mean annual increments (MAI) for the forest zones of Canada. The remote communities in this study lie in zones with MAI's of about 1.0 m^3/hectare/year. Considering the fact that the average family uses 15 cords (54 m^3) of stacked wood per year (34 m^3 solid volume), 34 hectares (85 acres) are needed to support each family on a sustainable basis. At the current level of consumption, Fort Chipewyan, for example, would require about 4,500 ha to provide fuel wood on a renewable basis.

Another method of calculating the availability of wood is on a gross volume basis. The forests around the communities are estimated to contain between 70 and 120 m^3 per hectare. Thus, on a clear-cutting basis, each hectare would support two to three and a half families for one year. In other words, a community like Trout Lake, for example, with 40 families would need to clear 12 to 20 hectares (30-50 acres) per year to meet its wood requirements. Therefore, assuming that 50 percent of the area would be cleared, a circle with a 5 kilometre radius should be able to provide enough fuel for over 200 years without allowing for any regeneration during that period.

The only community near a logging operation is Garden Creek. The community (population 150) could be considered for a possible wood gasifier installation if the project at Fort Providence, Northwest Territories (See Annex D), proves successful and if the volumes of forest waste are sufficient.

Another possible forest waste which is not currently utilized is the waste from land clearing for agriculture or highway rights-of-way or line-cutting for pipelines, drilling sites and seismic lines. There is a considerable amount of land clearing for agriculture between High Level and Jean d'Or Prairie and the trees are burnt after mechanical clearing. Based on the yields noted above, each section of land cleared (640 acres) could provide enough wood to supply a community like Trout Lake, for example, for about 12 years. Similar clearance of highway rights-of-way involves bull-dozing and burning. Each kilometre of 30 metre right-of-way has an area of 3 hectares (7.5 acres). Therefore, 4 to 6 kilometres of right-of-way could provide sufficient wood for one year for Trout Lake. The economics of using this resource have not been estimated but clearly demand some further study.

An alternative use of the resource would be to convert it to charcoal at the site using portable kilns. The product could be used with wood in existing stoves and may possibly be useful for maintaining fires overnight since it burns for a longer time than wood. The economics and technical aspects of production are unclear at this time and some of the questions which need to be addressed are:

a) Are the species of wood available suitable for charcoal manufacture?

b) Would charcoal be an acceptable fuel, technically and socially?

c) Would charcoal manufacture interfere with the land clearing or highway building process?

d) What are the costs of production and transportation of charcoal and how large is the market?

Regardless of the use of the forest wastes, if present use patterns are not changed significantly, there is sufficient wood in the vicinity of the communities to meet their needs for the foreseeable future.

4.5 Wind

Data from Environment Canada, Atmospheric Environment Services were obtained for the following stations in Alberta: Fort Chipewyan, Fort McMurray, High Level and Peace River. Data for Fort Smith, N.W.T., were also obtained. The communities in the study fall in the region bounded by these stations.

In general the wind speeds in the region are low and the percent of 'calm' time is relatively high, two factors which are unfavourable for electricity generation. However, wind regimes can vary considerably over short distances and it is difficult to rule out this resource based on the limited data available. For example, it was suggested that Fox Lake may be a good location because "the wind always blows" along the Peace River valley. Such a site would require monitoring before considering installation of a wind turbine.

The measuring station at Fort Chipewyan, one of particular relevance, is located at the airport which is on low-lying land with ridges rising to the east and west. Before wind energy could be ruled out at Fort Chipewyan, it would be necessary to measure speeds and durations in an elevated location. Apparently wind generators were used in the 1950's before the diesel generator was installed but no records exist. No analyses have been performed for wind turbines because of the scarcity of data in the region. However, wind energy is not likely to make any significant contribution to energy supply in these communities in the near future.

4.6. Solar

Data were obtained from Atmospheric Environment Services for measuring stations at Fort Smith, Northwest Territories, and Fort McMurray and Peace River, Alberta. Data available for each site include mean monthly radiation for each (global, diffuse and direct) and mean daily solar radiation on a sloped surface (global, diffuse and direct). The data reflect the northern latitude with measurable radiation for only 6-8 hours in December and January compared with 18 hours for June and July. The highest mean daily global radiation on a sloped surface ranges from 4.2 MJ/m^2 in December to 20-21 MJ/m^2 for March to July in Fort Smith. At Fort McMurray the range is from a low of 7.3 MJ/m^2 in December to 19-20.8 MJ/m^2 for April through August. These wide variations in available energy limit the applications for the resources particularly since energy demands are generally highest when the availability is lowest. The result is that solar systems would either require full back-up systems or they would be very large and expensive. The use of solar energy for thermal purposes appears to be ruled out on this basis.

Applications for photovoltaic electricity generation may be more attractive though not for residential purposes. The microwave towers near these communities (and other isolated locations) represent a relatively constant load throughout the year and it may be possible to meet all of the requirements for energy during the April - August period from solar energy. It would be unrealistic to size the systems to meet the demand in winter but diesel fuel could be saved during the summer months. A recent article in Engineering News Record (Ref. 16) quoted the average 1982 price for photovoltaic modules at $12.50 (Cdn) per peak watt. The cost for large installations has been reduced to as low as $6.90 (Cdn) per peak watt. These systems need to be examined carefully for applications in remote areas. The equipment needed could be eligible for the fast write-off allowance for Class 34 equipment (See Annex A, Federal program 7).

4.7 Waste Heat from Diesel Generating Plants

Waste heat from the diesel generating stations is currently not being used in these communities although the technology and economics of recovery are well established. Heat can be recovered from the exhaust or the cooling water or both and used to displace heating oil or propane used for space heating. A system to accomplish this goal was installed on an existing diesel generator at Cambridge Bay, Northwest Territories, in 1976 and has been operational since that date. The system is jointly owned by Northern Canada Power Commission and the Government of Northwest Territories. An assessment of this system was included in a report to Energy, Mines and Resources by Ferguson, Naylor, Simek Limited, Consulting Engineers & Planners, of Yellowknife (Ref. 11). Other heat recovery systems have been installed since then based on the favourable results at Cambridge Bay and new community buildings, including schools, are being designed to use waste heat from diesel plants (Ref. No. 19).

The amount of heat available from jacket water only is estimated to be about equal to the electricity generated and when both jacket water and exhaust are used, about 1.3 times the electricity generated. Therefore, the amount of recoverable waste heat potentially available in 1982 at the generating stations considered would range from a low of 178 MWh (640 GJ) at Chipewyan Lake with jacket water only to a high of 4900 MWh (17,800 GJ) at Fort Chipewyan with combined jacket water and exhaust heat recovery. The economics of retrofit installations are discussed in the next chapter.

CHAPTER 5

PRELIMINARY ECONOMIC EVALUATION OF SOME ALTERNATIVE ENERGY SOURCES

This section contains preliminary evaluations of some of the alternative energy sources and systems which appear to be most promising for the communities in this study. The analyses are based on published data which are believed to represent reasonable costs for the size and location of these communities. The purpose of the analyses is screening of alternatives and not assessment of particular projects and consequently, the only conclusions which can be drawn concern the need for more detailed consideration. All prices and costs are in 1982 dollars.

5.1. Wood Gasification for Electricity Production

Crippen Consultants completed Phase I for a study on wood gasification and small hydro generation for Indian Reserves for DINA in March 1982 (Ref. No.3). The types of gasifiers available were described but costs were not estimated because units in use tend to be experimental and modifications are often made after installation. One of the conclusions of the report was that completely reliable units are not yet available and that any installations made in the immediate future must be considered partially experimental (pg. 2-47). The study, a national screening for potential sites, also estimated the amount of wood required for each Reserve considered and the amount available as well as the labour requirements. An adequate supply of suitable fuel was considered available in most locations. To run a gasifier on a continuous basis, the study concluded that four to six people would be required. Phase II of the study is intended to address the technical and socio-economic issues of wood gasification for electricity generation.

Since the Crippen report was published, EMR has contributed to the cost of a wood gasifier demonstration project at Fort Providence, Northwest Territories, under the Canada/Northwest Territories Conservation and Renewable Energy Demonstration Program. The installation was completed in May 1982 at the Snowshoe Inn at a total cost (including estimates for monitoring) of $523,500 with the Federal Government contributing 52 percent of the cost. The purpose of the project is to demonstrate the feasibility of an automated plant providing power and heat to a 3400 m^2 complex. The engine would drive a 120 kW generator with jacket and exhaust heat recovered for heating purposes. The Imbert gasifier was assembled and tested in West Germany and is similar to the 1000 kW model tested by the Saskatchewan Government.

The estimated diesel fuel savings from the electricity generated amount to 170,000 litres in the first year. The total savings in fuel costs including heating oil, amount to an estimated $45,700 and the required wood is expected to cost $25,300. Thus, gross savings in the first year would be $20,300. The project summary is included in Annex D. The following analysis of the project is based on reported costs in the summary, expected future increases in diesel fuel costs, and assumptions regarding future demand. Details of the calculation are shown in Annex D.

Assumptions

a) The power and heat required will remain constant during the life of the project.

b) The equipment has a 25-year useful life.

c) Diesel and heating oil costs increase at 3.0 percent per annum in real terms during the project life, in accordance with recent EM&R projections (Ref. No. 10).

d) Annual operating costs of the automated wood gasifier plant amount to 2 percent of capital costs.

e) The discount rate is 6 percent per annum.

f) Without the plant, electricity will be provided from a diesel plant and annual operating and maintenance costs will amount to 5 percent of fuel costs.

g) The cost of wood is $45 per cord as quoted in the Project Summary and does not increase in real terms.

h) The capital costs for the diesel plant are based on 120 kW at $1500 per kW.

The present value of the costs of energy supply for the twenty-five year period are as follows:

Diesel fuel and heating oil	$1,006,000
Wood gasifier with heat recovery	$ 980,500

Thus, at a six percent discount rate (constant prices) the present value of the net savings of the gasifier over a diesel-oil combination amounts to $25,500 over the 25-year period. However, if diesel and heating oil prices are assumed to remain constant, the present value of the cost of the diesel-oil combination is reduced to $787,000 and the gasifier would not be justified. Another critical element is the cost of wood. The going price in Alberta is about $80 per cord rather than the $45 per cord quoted in the project summary for Fort Providence. At a price of $80 per cord, the gasifier would be uneconomic even at escalating prices for diesel oil and heating oil.

The actual results of the project will not be available until mid-1983 and no other installations of this type should be made until the data have been analyzed, including an assessment of the reliability of the equipment. The one community which could potentially benefit from the technology is Garden Creek which is near a logging operation. Key issues to be addressed are the volumes of wood waste available and its price.

5.2 Natural Gas Pipelines

The estimated costs in this analysis were obtained from the provincial Department of Utilities and Telephones and are based on a similar project which was completed in 1982. The costs for a specific supply project would,of course, need to be worked out in detail before any decisions are made. The analysis here is intended for screening purposes to determine whether additional study is warranted. Two communities are selected for this analysis: Jean d'Or Prairie because it is the closest to an existing natural gas pipeline, and Chipewyan Lake because it is in an area where natural gas has been discovered and is being brought on stream.

Jean d'Or Prairie is about 50 kilometres from gas service at Fort Vermilion. If gas were supplied to this community it could substitute for all of the current uses of propane, diesel fuel, and heating oil and could meet the expected future increases in use. The cost of converting propane burners to natural gas burners would not be large. The cost for new engines for electricity generation is estimated but the cost for heating oil conversions is not included since most of the estimated future use would be for new customers. The total capital costs for the system, including the cost of conversions, is $1,245,000. The details of this estimate are given in Annex E.

The following assumptions are made for this analysis:

a) There is no growth in energy demand after 1990.

b) The prices of diesel and heating oil increase at a real rate of 3.3 percent per year until 1990 and at 2.6 percent thereafter.

c) The price of propane increases at 3 percent per year from 19.5 cents/litre in 1982.

d) The price of natural gas increases at 3 percent per year.

e) Additional electric capacity will cost the same for diesel or natural gas systems.

f) Operation and maintenance costs for end users will be the same regardless of fuel source.

g) The annual operation and maintenance costs for the gas pipeline system will amount to 2 percent of capital costs.

Based on these assumptions, the present value of the natural gas system is $3.1 million compared with the present value of the existing system of $4.8 million, over a 25-year period. (See Annex E for details). This preliminary analysis shows that connection of Jean d'Or Prairie to the gas distribution grid is worthy of consideration. However, the payback period, accounting for accrued interest at a real rate of 6 percent, would be 14 years, which may be too long to render the project attractive from the point of view of commercial financing. Care should be exercised in comparing this opportunity directly with the transmission line option, discussed hereafter in Section 5.4, because the gas scheme would provide for Jean d'Or Prairie only. While the transmission line, as considered, would serve both Jean d'Or Prairie and Fox Lake service to Fox Lake would require a crossing of the Peace River, which would not be economically attractive for a gas pipeline. A further step in the analysis would be to consider installing natural gas service in Jean d'Or Prairie with a local electric connection to Fox Lake so that the diesel fuel used for generating electricity in Fox Lake could be displaced. This analysis is not included in this report.

For Chipewyan Lake natural gas supply, the following assumptions are made:

a) The capital costs for field production and gathering systems are assumed to be included in the price of gas. Capital costs for transmission and distribution are listed in Annex E.

b) The natural gas price was $3.42 per GJ in 1982 and is estimated to increase at 3 percent per annum between 1982 and 2000 (EMR forecast).

c) Diesel price is expected to increase at 3.3 percent until 1990 and 2.6 percent thereafter.

d) All heating and electricity requirements can be met with natural gas, except for current heating by wood which will continue to be used.

e) Additional capital investment for electricity generation would be the same regardless of the fuel source.

f) Annual operating and maintenance costs for the natural gas distribution system would be 2 percent of capital costs.

g) Energy requirements grow according to the projections in Chapter 4.

Details of the calculation are given in Annex E. The present value of 25-year costs for the options is estimated to be $1.4 million for diesel and propane and $916,000 for the natural gas system. This preliminary analysis indicates the desirability of using gas in Chipewyan Lake even though existing capital invested in diesel engines is not considered. It should be pointed out that the benefits do occur over a long period and the project may not meet the payback requirements for commercial financing. Relaxing the price escalation assumptions would result in a reduction but not in the elimination of the apparent advantage of gas distribution.

5.3 Waste Heat Recovery from Diesel Engines

The technology for recovering waste heat from diesel engines is well proven and equipment is readily available for new installations or for retro-fitting existing engines. Heat can be recovered from the jacket cooling water, the exhaust gases, or both. There are several types of systems for recovering the heat, the simplest (and least expensive) being a heat exchanger transferring heat from the jacket water to another fluid such as water or a water and glycol mixture if freeze protection is required. A report submitted to EMR in 1981 contained a description of the various systems, costs, and amount of heat recoverable (Ref. 11).

Before a heat recovery system is installed on a diesel engine it is necessary to find a buyer for the heat. This often creates problems because of the different interests of the two parties, supplier and user of energy. The supplier wants to ensure that his equipment is protected while the user wants the energy to be delivered in proper quantities at the correct time and temperature. There are additional problems in setting the price and deciding on the ownership of the equipment. Noise is also a potential problem but adequate construction methods can reduce noise levels significantly, considering that equipment required for the recovery of exhaust heat has also a noise-reducing effect.

A pilot system was installed at a diesel generating station at Cambridge Bay, Northwest Territories, in 1976 and cost a total of $120,000 for all plant and building modifications and saved the equivalent of 50,000 gallons (225,000 litres) of heating oil annually. The 'gross system payback period' was estimated at approximately two years. This suggests that heat recovery can, under appropriate conditions, be a very attractive proposition.

In the communities under study, another problem to be faced is the distance from the electricity plants to potential users. In general, the plants have been located away from potential users of recovered heat because of noise and safety problems. For example, the diesel plant at Fort Chipewyan was recently relocated and is now about two kilometres outside of the town. The only communities in which there are any sizeable energy users near the electricity plant are Jean d'Or Prairie and Peace Point. In Peace Point, a new generating plant is to be installed and the location has not been finalized. In Jean d'Or Prairie, the plant is located close to the Band Council offices and a workshop/garage which is under construction, while the new nursing station is about one-half kilometre away.

Another possible location where waste heat could be recovered and used is at Garden Creek where Alberta Power Limited plans to install a generating station in 1983 and where a new school is also in the planning stage. Alberta Power Limited has estimated costs for heat recovery equipment at this new plant to be about $50,000 for jacket water only. The heat required at the new school needs to be calculated along with the cost of supply from both propane and waste heat recovery so that the heating equipment at the school can be installed to use the least-cost source. The details of ownership of the equipment and price to be paid for recovered heat also need to be worked out to the satisfaction of both sides.

5.4 Electricity Transmission Line

This option is included here even though Alberta Power Limited regularly monitors costs of such construction. The analysis which a private investor undertakes is, understandably, different than the following analysis since such projects would be competing for scarce capital resources. The discussion is not intended as a criticism of Alberta Power Limited practices but is intended to illustrate the benefits when a long time period is considered.

For most of the communities studied transmission lines operating at 25 kV would be adequate. For Fort Chipewyan, however, it would probably be necessary to install a 72 kV line because of the long distance involved, if this option is attractive. Costs for 25 kV transmission lines range from $15,000 to $21,000 per kilometre while the 72 kV line would cost about $62,500 per kilometre. Table 5.1 shows the distances from the grid to the various communities and the estimated costs of the transmission lines and substations. The cost of diesel fuel for generating electricity in each community in 1982 is included in the table. Analyses of all of the projects have not been performed but the following paragraphs describe the results of calculations for two possible interconnections.

A preliminary economic analysis has been performed for supplying power from the grid to Fort Chipewyan and to the combination of Jean d'Or Prairie and Fox Lake. The details of the calculations and the assumptions are included in Annex F. The assumptions regarding future energy requirements are consistent with the estimates contained in Chapter 3 to 1990 while requirements after 1990 are held constant at the 1990 level. This assumption will understate the costs of diesel-generated electricity more than the cost of the grid-supplied electricity if further price increases of fuels are considered likely. The increases in the price of diesel fuel are based on real price increases in EMR projections contained in 'Supplementary Information on Canadian Energy Supply/Demand Outlook, 1981 - 2000', June 1982 (Ref. 10).

The analysis in Annex F shows that for Fort Chipewyan the present value of energy costs from 1983 to 2007 from the diesel system would be about $14.1 million (1982 dollars) while the costs from the grid would amount to an estimated $17.8 million. The transmission line does not appear viable for Fort Chipewyan under these assumptions and the qualifications listed hereunder. If the assumption regarding escalation of fuel prices is relaxed so that there are no real price increases in the future, the diesel-based system has a present value cost of $10.2 million for the 25-year period.

Several other considerations make the investment in a transmission line to Fort Chipewyan a doubtful proposition. First, the reliability of such a long, single-circuit line would need to be assessed and the cost of any probable outages would have to be subtracted from benefits. Second, there is a question of the technical acceptability of a relatively large load at the end of a long transmission line and reactive power may be necessary. A third consideration, for Fort Chipewyan and the other communities, is the long payback period which would reduce the attractiveness of the investment to a private company. Project benefits accrue over a long period and increase from year to year as a result of the growth in demand for power and the assumed increase of fuel prices. Finally, in the case of Fort Chipewyan, the prospects of a possible implementation of the Slave River Hydro project make a consideration of a line from Fort McKay, the closest point on the grid, particularly unattractive.

For Jean d'Or Prairie and Fox Lake, the diesel supply option would cost an estimated $7.3 million (present value, 1982 dollars) while the supply from the grid would cost about $4.4 million. This transmission line appears viable and deserves further study in conjunction with the other options that are available, namely, the use of natural gas for fuel substitution and the development of a small hydro plant at Vermilion Falls. These two options are discussed elsewhere in this chapter.

It is important to recognize the effects of fuel price escalation on the diesel-based system for Jean d'Or Prairie and Fox Lake and when the assumption is relaxed to remove real fuel price increases the present value of estimated costs for this option falls to $5.3 million, closer to but still well above the estimated value for the transmission line option. Another factor to be considered in this analysis is the 8-year payback period for the transmission line which may not be sufficiently attractive for commercial financing. The reason that the option looks attractive in present value terms is that large benefits occur late in the 25-year period when demand has been assumed to have grown and fuel prices to have escalated.

5.5 Substitution of Wood for Propane or Heating Oil

The availability of sufficient wood resources within reasonable distances of the communities has been noted in Chapter 4 and this source could be considered for space heating in those buildings which currently use non-renewable energy sources. Propane is considered to be in sufficient supply in Alberta because it is a by-product of natural gas production. However, from the point of view of the communities, there are advantages in obtaining a degree of independence from external energy supplies. For example, such a replacement would provide the benefit of employment in the communities for supplying wood and for maintaining the fires for 24 hours a day during the heating season. To evaluate the benefits of this substitution, the heating system for the school at Fox Lake is considered.

This school currently uses propane for all space and water heating and the cost in 1982 was about $43,000 for 220,000 litres. To replace this energy source with wood the following assumptions are made:

a) The propane system operates at 65 percent efficiency.

b) Wood systems would operate at 55 percent efficiency.

c) The wood contains 13.7 GJ per cord (stacked).

d) The energy content of propane is 25.6 MJ/litre.

The resulting requirements for wood are about 400 cords for the equivalent amount of useful energy. As noted in Chapter 2 the total amount of wood consumed in Fox Lake in 1982 was about 1,050 cords, thus indicating that supplying the school with wood would not be beyond local capabilties.

The conversion to wood-firing would require changes in the existing heating system which is not completely centralized. These costs are not estimated for this illustration. Additionally, two or three workers would be required for maintaining the fires. Based on a cost of $80 per cord of wood, the average of the range listed in Chapter 2, and on 700 man-shifts of employment per year at $50 per shift, the annual costs involved, ignoring capital cost would be as follows:

Cost of propane	$43,000
Cost of Wood (400 cords)	$32,000
Manpower costs, wood system	$35,000

Since the current cost of propane is $43,000, this substitution is not economic at current propane prices. If the existing system used heating oil (38.5 MJ/litre) at a price of 34 cents/litre and an efficiency of 60 percent, the cost for providing the heat required would be about $54,000. Again, wood is not competitive with heating oil under these pricing assumptions. The price of wood quoted in a similar study for Manitoba (Ref. No. 12) is also $80 per cord but the price assumed for the wood gasification project at Fort Providence, Northwest Territories, was $45 per cord. At this lower price of wood, replacement of heating oil by wood could be considered under conditions as described but replacement of propane would remain uneconomic. It would be possible, however, to reduce the significant cost of manpower required to maintain the fires by chipping or pelletizing the wood and installing automatic feeders. Replacement of heating oil by wood would then be attractive, probably, but only if the cost of wood is of the order of $45 per cord as reported for Fort Providence in the Northwest Territories.

CHAPTER 6

ENERGY CONSERVATION - DEMAND REDUCTION MEASURES

The potential for reducing demand for energy in the remote communities is discussed in qualitative terms in this chapter. To be more definitive it would be necessary to audit buildings (the predominant energy users) in detail and the limited scope of this study did not permit such measurements. However, it is possible to draw some conclusions based on observations during the visits and on discussion with owners, users, builders and operators.

6.1 Residential Sector

As noted in other chapters of this report, there is wide variation in the residential sector in the type of housing, the energy source and the building conditions. This discussion is broken into two parts to cover the Native and Metis housing and the non-Native housing.

Native and Metis Housing

The primary energy uses in these homes are wood for heating and cooking and electricity for lights and small appliances. Energy use per household is low as evidenced by the low average for electricity consumption. During the winter, one of the largest single electricity loads for some families is the vehicle block heater. Some homes use propane or electricity for cooking but these homes probably total less than 20 percent of all homes in this category.

The condition of the houses ranges from very poor to very good with a considerable number due for replacement (see the photographs of typical houses in Appendix 2). The provincial Rural Home Assistance Program is having an impact on this situation in those communities which are not on Reserves and in the Program's six year history the building techniques and construction materials have improved. The newer homes still use wood as the main heat source but volumes consumed are as a low as one-third of that for the older housing. As the photographs show, older houses lose a lot of heat through the roof causing ice build-up from melted snow. The newest homes almost invariably have no such problem.

The main objective of the program is to replace old houses but this does not always occur. The houses are often recycled as other families move into the vacated houses. The new houses being built in the other communities not included in the program are also more efficient

than the older houses and the average household consumption of wood will probably decrease in the future. To reduce consumption in existing stock it will be necessary to visit each house and determine whether it is best to improve it or replace it. In the meanwhile, as long as the older houses are being used, an effort should be made to ensure that low cost measures, such as polyethylene storm windows, weather-stripping and insulation, are taken to keep the heat in the houses.

As noted elsewhere in this report, the future energy consumption in these homes will change as freeze protection will be required when water service is provided. It will be important to ensure that all energy sources are used efficiently and effectively.

Another change which could reduce the amount of wood consumed would be to change the time of year when wood is cut. Currently most of the wood is cut shortly before it is burned instead of allowing it to dry. As a consequence much of the heating value escapes up the chimney as evaporated moisture. The useful heating value of the wood could be increased by about 25 percent by reducing the moisture content from 40 percent to 15 percent (Ref. 3, page 2-6).

Electricity consumption is low on average but there are still possibilities for savings. One example would be block heaters which are quite often plugged in overnight whereas two hours would be sufficient. In the future electric water heaters will become more common. It is important that these heaters are efficient and savings could be obtained by having an uninsulated tank in a heated part of the house to preheat the water before it enters the electric heater.

A factor which discourages energy conservation is that many native families receive welfare payments in one form or another and they are reimbursed for the cost of energy as incurred. They have, therefore, little incentive to save energy.

Non-Native Housing

Fort Chipewyan is the only community with a significant number of permanent non-native residents. These residents are well aware of the high costs of energy and are consciously trying to reduce consumption. However, many of the homes are old and were not constructed with present energy costs in mind. Some of the homes have been improved

but, in general, the awareness of assistance programs is low. A specific survey of this housing segment could probably identify significant potential for savings since the primary heating fuel is furnace oil and heating needs in Fort Chipewyan are the highest in Alberta. At 7600 degree-days (18°C), the thirty-year average number of degree days is about ten percent higher than at any other measuring station in Alberta. With such a severe climate and high costs of fuel, triple-glazed windows may be cost-effective in new residences, particularly on north-facing walls, and deserve special attention. It is unlikely that retrofitting existing buildings with triple-glazed windows is cost-effective. Other standards for housing in the northern communities (not only those in this study) should be re-evaluated to ensure that cost-effective techniques are included in new construction and in retrofits. Specifically, the results of federal and provincial programs as relevant to the North in research and demonstration of housing energy efficiency should be applied and publicized in these communities.

In the other communities visited, the non-Native residents are primarily teachers and nurses. These people have housing provided and the condition of the houses varies. At Fox Lake there is a new 7-unit apartment building which was built with energy efficiency in mind and four trailers which are less efficient. Also at Fox Lake, the new nursing station has a wing with residences for two nurses and this building is quite efficient in its use of energy. In other communities the housing is of average condition and was not specifically designed for northern climates.

One factor mitigating against energy conservation in these homes is the fact that the residents never see their utility bills. The bills for teachers' residences are sent directly to Northlands School Division in Peace River while the Edmonton office of Health and Welfare Canada pays for the nursing stations. This practice releases the residents from any of the direct responsibility for keeping costs down and needs to be modified. A better method for giving the benefit of paid utilities to those who live in isolated areas would be to give them a specific allowance for heating and electricity, according to the condition of the houses, and have them billed for the service. It would then be up to the individual to use money and energy at his own discretion. This financial incentive would induce more awareness in residents and would lead to energy savings.

6.2 Commercial and Institutional Sector

The schools are by far the largest users of energy in these communities and they should be given particular attention in any program to reduce energy consumption. The schools are all operated by Northlands School Division except Bishop Piche School at Fort Chipewyan which is run by Indian and Northern Affairs. The schools at Trout Lake and Peerless Lake are new and they have been built to improved standards but use more energy than the previous schools, because they are larger than the ones they replaced and because they have been provided with pumps for water supply. A similar school is planned for Chipewyan Lake which currently has two portable classrooms and a heated lunch room. Fox Lake and Jean d'Or Prairie have schools which were built in 1979 and 1974, respectively, before designs had changed significantly. The school at Fox Lake also has 'temporary' portable units serving as classrooms. The Northlands school in Fort Chipewyan is a well-built structure with good insulation. Bishop Piche School is currently housed in a building of modular units which were installed in 1981 to replace the previous school which was destroyed by fire. Plans for a new permanent facility have not been finalized. Peace Point has a single portable unit. A new school is scheduled to be built by DINA at Garden Creek.

Almost all of the schools have some means of controlling temperature in each room, either a thermostat or a fuel flow setting on the space heater. However, none of them has automatic thermostats for reducing overnight temperatures. Some have day-night settings on the thermostats but apparently this gadget does not work properly in many cases and must be set manually. One of the reasons quoted for not having automatic setbacks was that voltage and frequency fluctuations in the electricity supply affect the clocks and, therefore, disrupt the functioning of thermostats. This could easily be overcome with a battery operated clock.

As with the teachers' residences, bills are not sent to the communities and the principals have only a vague idea of how much the energy costs. It might be more effective to include the principal in the process by having energy costs included in his budget and having him approve the bills for payment.

Another aspect of the schools at Fox Lake and Jean d'Or Prairie is the division of ownership and tenancy. The schools were built by DINA and turned over to Northlands School Division for operation. Northlands is apparently free to make any changes it considers appropriate but it has a tendency to avoid any capital expenditures except minor improvements such as weather-stripping. This arrangement needs to be clarified or altered to facilitate future improvements.

At Chipewyan Lake, the school year was modified in 1982 so that classes were held during the summer and December and January were substituted for the "summer vacation". This practice undoubtedly reduced energy consumption although the data (as yet not available for the school year) will require some analysis to remove the weather effects. Saving energy was not the motive. The experiment was tried because absenteeism can be high in the winter for two reasons: first, the winter road allows visits to other communities whereas this community is isolated in the summer, and second, some families are out of the community for extended periods while trapping. The reaction has been mixed and a decision has not been made on continuing with the schedule. When such a change was suggested to the principal at Bishop Piche School in Fort Chipewyan, his reaction was negative, citing the fact that absenteeism is lowest when the temperature is lowest (it's warmer at school than at home). He also suggested that teachers would react negatively to such a schedule. It is clear that any changes in school schedules could not be introduced for energy savings alone but would need another justification.

Three new schools are to be built in the near future and it is important that the design allow for the minimum feasible energy consumption. The new school at Garden Creek is planned to be built to general federal government energy standards which probably are inadequate for the climate and for the high cost of fuel in these locations.* The design has not been finalized for the other schools. For the existing schools, it is important to carry out a full-scale audit of each to determine what improvements can be made. The provincial program of School Energy Conservation should be extended to those schools immediately since the savings can have a significant impact on diesel fuel (electricity) and propane use. Once the audits have been performed, the energy system should be automated as far as possible. For example, with the high cost of electricity being generated from diesel fuel it will be easy to justify timers on lights and other electrical equipment. These actions should be taken as soon as possible.

* Recently schools and community facilities in the Northwest Territories have been designed specifically for those locations (Ref. No. 19).

The other users in the sector do not consume energy in quantities as large as the schools but they deserve attention. The users range from Band Council offices to pumping stations, health clinics, and general stores. The condition of these buildings ranges from poor to excellent. One example of poor buildings is the 4-room motel in Fort Chipewyan. It uses a forced-air, oil-fired heating system with one thermostat controlling the heat to both the restaurant and the rooms and the result is overheating in the rooming area because the restaurant has a door opening directly to the outdoors. There is no double entry to reduce infiltration. The building has single-glazed windows and probably very little insulation. Energy consumption for heating this building could be reduced significantly with some obvious modifications. Another case where energy savings could be achieved is in electricity consumption at the Hudson's Bay store at Fort Chipewyan (and probably at the other stores serving the communities). The largest use of electricity is for refrigeration and, with some modifications, this function could use outside air during the winter to reduce electricity use. The savings and costs of these modifications would need to be assessed in detail but it appears to be an attractive option.

To achieve savings in the commercial and institutional sector in these communities it would be worth having qualified energy auditors visit each user. Necessary changes in building structure and operation could be identified and the owners could be informed of the information and equipment available. The small number of buildings and operations in this category makes such an approach practical and the savings in diesel fuel, heating oil, and propane could be achieved within a short time.

CHAPTER 7

BARRIERS TO DEMAND REDUCTION OR FUEL SUBSTITUTION

Throughout this report there have been references to the difficulties associated with various fuel saving options and to problems in using different fuels or in modifying operating or building techniques. These barriers to more rational energy use are discussed systematically in this chapter.

7.1 Financial Barriers

This category covers several different types of problems ranging from budgeting procedures to pricing policies. These are identified with examples as follows:

a) Pricing policies

The prices of the different energy sources, except wood, are controlled by the provincial government. It also provides rebates on propane or heating oil used for residential purposes in areas where natural gas is not available to bring the cost of those fuels in line with natural gas. This subsidized cost of fuel reduces the incentive for home owners to conserve energy. In general, the prices of propane and heating oil are not high enough in Alberta to justify converting large users (schools, nursing stations) to wood-based heating systems (see Chapter 5).

b) Payment of Energy Bills

Energy costs are often paid for residents through a number of mechanisms: teachers bills are paid by Northlands School Division, the nursing station bills (including residential) are paid by Health and Welfare, and those on social allowance receive reimbursements for costs. The effect of having energy bills paid or reimbursed at cost by a government agency is, as far as an incentive to save energy is concerned, similar to the effect of a subsidy of 100 percent.

c) Budgeting Procedures

Discussions with staff of Federal Departments such as Health and Welfare and Indian and Northern Affairs indicated that they are generally interested in keeping down the capital costs of new buildings. For these northern locations, this often results in higher operating costs for energy consumption. Designs for new buildings are in accordance with general federal government standards for energy conservation but lower life cycle costs (capital plus operating) could be achieved if designs were modified to consider the climate and recent advances in construction techniques.

d) Ownership

This is an extension of the above problem. In the case of some facilities one agency is the builder, interested in reducing capital costs, while another agency accepts responsibility for operating and maintenance. The result is that the operator is reluctant to incur capital costs which would reduce energy costs. A similar situation exists in the residential sector where the occupant often lives in a house built by the Band or a government agency.

e) Payback Periods

For electricity and gas supply, the payback periods for [illegible] fuel substitution are often longer than required [illegible] by commercial financing, though, as indicated in Chapter 5, the long-term benefits can often outweigh the costs.

7.2 Technological Barriers

For alternatives to existing fuels there are often drawbacks which need to be overcome. Whereas diesel generators are reliable and simple and can be run for long periods without any skilled attendants, the same is not true for wood gasifiers, for example, which have yet to be proved in commercial operation in northern climates. Similarly, a training program for operators would be required if a natural gas distribution system were to be built to serve a remote community. Another technological barrier resides in the skills of local builders, although the Alberta Housing and Public Works program has shown that this can be overcome with training and with skilled supervision.

7.3 Information Barriers

As noted in Chapter 1, the residents of isolated communities do not indicate much awareness of the programs available to them. Annex A lists 34 federal programs administered and 16 provincial programs administered by several agencies. Often the intended recipients are not aware of these programs. Many of them are available only on request, or on a volunteer basis and the information is not reaching these communities. In addition, the results of other programs, such as those in energy efficient housing, are not being promoted in the remote communities where, by virtue of their northern location, the benefits may be greater than in the locations where the original studies were carried out.

7.4 Institutional Barriers

The budgeting and ownership problems cited above could be classified as institutional barriers. An additional problem occurs in the use of waste heat recovered from diesel engines. The technology is readily available yet there are problems of ownership, operation, and pricing which need to be addressed before this energy source can be used widely.

7.5 Summary

These barriers are not insurmountable but they should be addressed when new programs are introduced or when existing programs are modified. This study did not include a full evaluation of the the effectiveness of the programs and, consequently, specific recommendations are not included. However, the following suggestions are included to illustrate the possible approaches to the problems. The problems of design for northern climates could be overcome by requiring increased standards in areas with more than a certain number of degree-days of heating required. Information barriers can be alleviated by having a single source knowledgeable in all programs who could act as a community contact. The use of waste heat from diesel engines could be promoted by giving tax benefits or grants similar to CDSP grants. For substitute sources such as natural gas or electricity from the grid, tariff arrangements could be made in cooperation with government users to ensure that payback periods are suitable for commercial financing. These and other solutions should be considered when assessing future energy supply and use options in isolated communities.

CHAPTER 8: FINDINGS AND CONCLUSIONS

8.1 The gross demand in 1990 for oil-based fuels in the remote communities is projected to be about 4,100 m^3 of diesel fuel, for electric power generation and 2,100 m^3 of heating oil. (Table 3.1)

8.2 Heating oil is a minor fuel in all of the communities except Fort Chipewyan. In the other communities propane is the primary source of energy for space heating in large buildings. The residential sector uses wood as its main energy source. (Chapter 2)

8.3 Unless action is taken, the use of heating oil will increase from current levels of consumption as other services, such as water and sewer, are provided. To introduce propane or better wood stoves for overnight heating will require special efforts. (Chapter 3)

8.4 The potential for energy conservation, for both petroleum products and electricity, is probably large in the schools and teachers' residences. The operating patterns and existing equipment (thermostats, controls) can be modified to achieve savings. Occupant habits can be changed by having them pay their own bills and giving them an allowance for energy costs. (Chapter 6)

8.5 There is potential for heat recovery from the diesel generators but the generators are normally not near major heat loads. New schools are to be built in three communities (Fort Chipewyan, Chipewyan Lake, Garden Creek) and it appears that only in Garden Creek will the school be close to the generator. (Section 5.3)

8.6 The electricity supply options are limited by the distances from the grid, the size of the load, and the availability of other resources.

- In Chipewyan Lake electricity could possibly be generated using natural gas engines at lower cost than the cost of diesel oil. The gas would also displace propane use. (Section 5.2)

- For Jean d'Or Prairie and Fox Lake, the options which need further investigation are natural gas from Fort Vermilion, an electricity transmission line from Fort Vermilion, and a small hydro project at Vermilion Falls. (Sections 5.2, 5.4, 5.6)

- Natural gas may become viable at Peerless Lake and Trout Lake in the future if gas is discovered and brought into production. (Section 4.1)

- An electricity transmission line to Fort Chipewyan from Fort MacKay does not appear economic at this time. However, if the Slave River Hydro Project goes ahead, Fort Chipewyan could possibly be supplied from that source although this would not occur for at least 10 years. (Sections 5.4, 4.2)

8.7 New housing in the communities is being built with efficiency of energy use in mind. The Alberta Rural Home Assistance Program is improving construction practices and the amount of wood consumed is considerably lower than for older houses. However, there are variations in the quality and in the techniques used. (Section 6.1)

8.8 New schools and other public buildings should be designed for northern climates and not based on national standards. Increased insulation thicknesses and triple-glazing of windows are two techniques which could reduce consumption of fuel. (Section 6.2)

8.9 The use of solar photovoltaic panels may be cost-effective for microwave towers where the load is fairly constant during the year. Because of declining costs for such system, this option deserves further attention. (Section 4.6)

8.10 Wind energy is limited in the area and monitoring stations would be required to determine the potential at specific sites. (Section 4.5)

8.11 Wood resources are sufficient for foreseeable demand. Some changes in cutting and storage habits would reduce the amount required to meet heating and cooking needs. At current prices wood is not competitive with propane for large heating loads. (Section 6.1, 5.5)

8.12 Waste wood from land-clearing operations is currently burned. The option of converting it to charcoal may be attractive and deserves further attention. (Section 4.4)

8.13 Per capita energy use in the communities will grow during the next decade but will remain below the level in less-isolated areas of the province. (Chapter 3)

8.14 Awareness of federal and provincial programs in the energy sector is generally low although some programs, such as the Rural Area Heating Allowance rebates, enjoy wide popularity. (Section 1.2)

8.15 A number of financial and institutional relationships common in isolated northern communities discourage efficient use of energy. Many users do not pay for costs incurred by them and building operators are frequently not responsible for construction of the buildings. (Chapter 7)

8.16 The conclusions of this study regarding energy use probably apply to other small communities in Alberta which have grid connections but no natural gas service. The conservation potential would have to be assessed on an individual basis but is probably significant. The conclusions regarding energy sources probably have little relevance to other provinces where prices, for petroleum products in particular, are higher.

CHAPTER 9

POSSIBLE DEMONSTRATION PROJECTS

The primary purposes of this study were to provide a profile of the energy demand and potential supply characteristics for the communities and to assess opportunities for using locally-available energy resources, for conserving energy, or for using alternative energy sources. The suggestions which follow result from the conclusions of the previous section and from the preliminary economic evaluations which have been performed. Some of these suggestions could be implemented as demonstration projects under Phase II of the Remote Communities Demonstration Project.

9.1 The alternatives for supplying energy to Jean d'Or Prairie and Fox Lake, which include connection to the electric power or the gas distribution grid, should be investigated in more detail. The assumptions and costs need to be refined so that decisions can be taken. There is also a possibility for installing a small hydro project on the Peace River using a small fraction of the flow diverted around Vermilion Falls. If viable, this project would be an excellent choice for Phase II as it would be demonstrating a different technology than other small hydro projects which frequently use the full flow of a small stream over a larger head.

9.2 A detailed study of supplying natural gas to Chipewyan Lake from a nearby field should be performed. Gas could provide energy for electricity and space heating and would be available for future space heating and water heating needs when the houses are supplied with running water. In evaluating such a project it will be necessary to assess the impact of reduced electricity costs on government users (such as the proposed new school) who now pay the surcharge for fuel costs of 9.05 cents/kWh for consumption in excess of 500 kWh per month. A portion of these savings could perhaps be passed on to Alberta Power Limited if an incentive is needed to expedite the conversion of generating facilities.

9.3 A program to improve information flow to the isolated communities should be implemented. One government office should be assigned responsibility for identifying the available programs and information on the benefits obtained elsehwere, publicizing the programs and responding to requests. This service could also be provided to other residents of the province.

9.4 One community could be selected to demonstrate the effects of a concerted energy management and conservation program. Fort Chipewyan would be a logical choice because it consumes the largest quantities of petroleum products and is unlikely to be served from any other source in the near future. The program should include all sectors and concentrate on low-cost measures. The results from Fort Chipewyan would be transferable to other communities.

9.5 The possibility of using portable kilns to convert waste wood from land-clearing operations into charcoal for domestic fuel needs to be assessed. Clearing for highways, seismic lines and drilling locations is on-going in the area near Trout Lake and Peerless Lake and the technology could be demonstrated in this area, if it is technically and economically attractive.

9.6 The use of waste heat from diesel engines should be considered for Garden Creek. This community was not studied in detail but there are plans for a new school and a new generating plant and the opportunity exists to use this proven technology and to overcome the institutional barriers. The possibility of relocating generating facilities closer to major heat loads in the other communities should be investigated.

APPENDIX 1

References

APPENDIX 1

REFERENCES

1. Peat Technology Research Project; L.J. Rak Engineering Ltd., October 1982.

2. Natural Gas for Rural Locations; Alberta Utilities and Telephones, May 1982.

3. Feasibility Study for Wood Gasification and Small Scale Hydro Power Generation for Indian Reserves. Phase I - National Screening; Crippen Consultants for Indian and Northern Affairs Canada, March 1982.

4. Renewable Energy in Remote Locations: Energy Demand and Resource Base; Energy, Mines and Resources Canada, Report ER 80-9E, October 1980.

5. Indian Conditions: A Survey; Indian and Northern Affairs Canada, 1980.

6. Alberta Electric Industry Annual Statistics 1980; Energy Resources Conservation Board, Report ERCB 81-28

7. Considerations for Small Hydro Developments in Off-Grid Locations; Lanmer Consultants with R.L. Walker & Partners Ltd., for EMR, Pre-Publication Copy.

8. Alberta's Hydroelectric Energy Resources; Energy Resources Conservation Board, Report ERCB 81-E, May 1981.

9. Microhydro, Volumes 1 and 2; Energy, Mines and Resources Canada, Report ER80-9E, October 1980.

10. NEP Update 1982, Supplementary Information on Canadian Energy Supply/Demand Outlook; Energy, Mines and Resources, June 1982.

11. An Inventory of Major Diesel Generating Systems in Canada and an Assessment of the Potential Markets for Heat Recovery; Volumes 1 and Appendix to Volume 1; Ferguson, Naylor, Simek Ltd., for Energy, Mines and Resources, 1981.

12. Energy Profiles for Manitoba Remote Communities; Unies Ltd., for Energy, Mines and Resources, January 1983.

13. Peat and Coal; Energy, Mines and Resources Internal report; Henry Mah, File No. CR 3830-1, September 1982.

14. Utilization of Micro-hydro in Remote Communities; Energy, Mines and Resources Internal report, file No. CR3830-1, August 1982.

15. Compendium of Federal and Provincial Energy Conservation and Off-Oil Programs; Middleton Associates, June 1982.

16. Falling Costs Keep Markets Looking Up; Engineering News-Record, Vol 210, No. 2., January 13, 1983, pp. 32-39.

17. Statistics Canada, Selected Characteristics for Alberta; August 1982.

18. Slave River Hydroelectric Project: Local Economic Assessment; Bahnuik and Wright, March, 1982.

19. Form and Function North of 60....A-E Firm Designs for Northwest Territories Residents; Canadian Consulting Engineer, February 1983.

APPENDIX 2

Photographs of Representative Structures

in Remote Communities in Alberta

ANNEX A

Federal and Provincial (Alberta)
Energy Conservation and Off-Oil Programs

FEDERAL

Program Profiles

Code	Title
FED - 001	Conservation and Renewable Energy Demonstration Agreements (CREDA)
FED - 002	Conservation and Renewable Energy Demonstration Program in PEI
FED - 003	Energy Conservation Research and Development
FED - 004	Ener$ave Advisory Service Program
FED - 005	Canadian Home Insulation Program (CHIP)
FED - 006	Super Energy Efficient Housing Demonstration Program
FED - 007	Canadian Oil Substitution Program (COSP)
FED - 008	Enhanced Conservation Assistance Program (ECAP)
FED - 009	Motor Vehicle Fuel Consumption Program
~~FED - 010~~	~~Arctic Community Demonstration Program~~ cancelled
FED - 011	Industrial Energy Research and Development (IERD)
FED - 012	Class 34 Energy Conservation Equipment Fast Write-Off
FED - 013	Industrial Conservation Task Force Program
FED - 014	Atlantic Energy Conservation Investment Program (AECIP)
FED - 015	Building Technology Support Program
FED - 016	Commercial Sector Task Force Program
FED - 017	Forest Industry Renewable Energy (FIRE)
FED - 018	Internal Retrofit Program
FED - 019	Internal Off-Oil Program
FED - 020	Development and Demonstration of Resource and Energy Conservation Technology (DRECT)
FED - 021	Energuide-Energy Consumption Labelling of Appliances

Federal Program Profiles (Con't)

FED - 022	Small Projects Fund
FED - 023	Ridesharing Centre
FED - 024	Driver Outreach
FED - 025	Truck Program
FED - 026	Propane Vehicle Conversion Program
FED - 027	Federal Propane Vehicle Conversion Program
FED - 028	Internal Energy Conservation Program
FED - 029	Residential Rehabilitation Assistance Program (RRAP)
FED - 030	Housing Technology Incentives Program
FED - 031	Heating Costs and Minimum Qualifying Income
FED - 032	National Energy Audit Program
FED - 033	Energy Bus Program
FED - 034	Remote Community Demonstration Program
FED - 035	Residential Insulation Contractor Certification Listing Program

ALBERTA

Program Profiles

Code	Title
ALTA - 001	Residential Awareness Prgram
ALTA - 002	School Curriculum Support Program
ALTA - 003	Rural School Visitation Program
ALTA - 004	Utility Company/Government Joint Programs
ALTA - 005	Industrial Energy Conservation Program
ALTA - 006	Vehicle Exhaust Testing (Clean Air Saves Energy - A Case for Tune-up)
ALTA - 007	Innovative Housing Grant Program
ALTA - 010	Farm Home Planning Course
ALTA - 011	Schools Conservation Program
ALTA - 012	Energy Awareness Program for Recreation Facility Operators
ALTA - 013	Energy Management Group
ALTA - 014	Agricultural Energy Conservation Activites
ALTA - 015	Alberta/Canada Energy Resources Research Fund
ALTA - 016	University of Alberta Energy Conservation Program

Federal Programs

1. Energy Conservation Research and Development

This program is administered by EMR but involves several other federal agencies. Its objective is to provide technical services, engineering, and operational systems development required for developing existing technologies or providing technologies which can be made available in the medium and long-term. Results of specific projects could have a bearing on future energy use in the remote communities but it is unlikely that there will be any near-term direct impact.

2. Enersave Advisory Service

Geared towards the residential sector, the objective of this program is to provide advice to householders on practical and economical ways to reduce energy consumption in homes. The service is available to all Canadians through a toll-free telephone advisory service and publications. A free computerized analysis of insulation requirements is available to owners and tenants of detached, semi-detached and row houses up to three stories. The program funding level is about two million dollars per year. It was introduced in 1977 and is on-going.

3. Canadian Home Insulation Program (CHIP)

Introduced in 1977, this 10-year program provides financial incentives for insulating and air-tightening residences built prior to September 1, 1977. The objective is to achieve a 30 percent energy saving in 70 percent of the entire housing stock built prior to that date. For Alberta (and most Provinces) the eligibility date is January 1, 1971 while for the Yukon, Northwest Territories, and Newfoundland the date is September 1, 1977. Taxable grants up to $500 are provided for materials and labour used for reducing energy consumption (insulation, weather stripping, vapour barriers, attic vents). The Central Mortgage and Housing Corporation is administering the program for EMR.

4. Super Energy Efficient Housing Demonstration

This program is for new housing and attempts to involve builders in the design and evaluation of demonstration houses. An average of $6,000 per house is available. The program includes training builders and tradesmen, site supervision, access for the public after completion, maintaining records of the construction process, publicizing and promoting the techniques used, and keeping records of energy performance once the houses are occupied. About 300 houses will be completed by spring 1983.

5. Canadian Oil Substitution Program (COSP)

This program provides financial incentives for converting heating systems in households and businesses from oil to any other energy source. It is a key part of the Government's Off-Oil Program. Buildings must have been built prior to October 28, 1980 and heated by oil prior to system conversion. If a partial substitution is made the new source must reduce oil consumption by one-half except for replacement by a solar energy source where a one-third reduction is required. Solar energy and solid fuel burning equipment (e.g. wood stoves) must be acceptable to COSP. Taxable grants covering half the eligible material and labour costs are provided to a maximum of $800 for a single family dwelling. The grant varies for other buildings from $1,000 to $5,500.

In Alberta, the grant applies for propane only if natural gas is not available.

6. Enhanced Conservation Assistance Program (ECAP)

This program is available only in Newfoundland, Prince Edward Island, the Yukon and the Northwest Territories. It is included here, however, because it may have relevance for isolated communities in other provinces. The objective is to encourage homeowners and small businesses to implement energy conservation measures and increase their use of renewable resources. A taxable grant is available for 50 percent of eligible costs to a maximum of $800. An on-site audit is performed to determine measures to be taken. The program is a special version of COSP for regions where natural gas is unavailable and a high proportion of electricity is generated with diesel fuel.

7. Class 34 Energy Conservation Equipment Fast Write-Off

This program is designed for industrial and commercial users with the goal of increasing energy efficiency, reducing oil use, and increasing the use of renewable energy resources. About the only eligible consumers in the remote communities under study would be the retail outlets and, possibly, the microwave towers. The fast write-off is applicable to machinery and equipment covered in Class 34 of the Income Tax Act.

8. Building Technology Support Program

This program covers residential, commercial, and institutional buildings and aims to accelerate and extend the implementation of energy conservation opportunities. Technical and economic information is provided on various technologies for achieving the goal. The program was introduced in 1981/82.

9. Commercial Sector Task Force Program

This program is aimed at energy conservation in commercial buildings. It is an information service. Separate task forces are being established for hospitals, churches, and hotels, motels and restaurants. The task forces, aided through EMR, establish and monitor conservation targets and prepare and distribute various forms of information.

10. Forest Industry Renewable Energy (FIRE)

This program encourages, through financial incentives, the substitution of wood residues and other wastes for fossil fuels in generating heat and/or electricity. Grants are available, covering up to 20 percent of capital costs for fuel handling and burning equipment.

11. Internal Retrofit Program

This program encourages and accelerates, through financial assistance and demonstration, the upgrading of property owned by federal departments and agencies to reduce energy requirements. The federal government, through EMR, helps finance energy studies and capital improvement costs for energy conservation. As part of the program, energy statistics will be generated for use in planning future energy targets.

12. Internal Off-Oil Program

This program is aimed at converting heating systems to reduce oil consumption by federal departments and certain crown corporations. The target is 40 percent reduction in oil usage over 10 years.

13. Energuide - Energy Consumption Labelling of Appliances

This information program is designed to improve consumer awareness and thereby stimulate improvement in the energy efficiency of major household appliances. Directories listing the energy consumption of competing appliances are printed twice yearly by the Department of Consumer and Corporate Affairs.

14. Small Projects Fund

Designed to encourage implementation of energy conservation measures in buildings and urban technology, this program provides financial support to workshops, seminars, demonstration projects, publications and studies.

15. Internal Energy Conservation Program

This program plans and promotes energy conservation and management, aiming to hold energy requirements of federal agencies in the fiscal year 1985-86 to at least 10 percent below that of 1975-76. Assistance is provided in establishing programs and in collecting and disseminating data.

16. Residential Rehabilitation Assistance Program (RRAP)

This CMHC program provides financial incentives for repair, rehabilitation or conversion of residential dwellings as well as promoting subsequent maintenance. The program is restricted to designated areas and properties must meet certain criteria. Borrowers meeting certain income tests may be forgiven portions of loans which are at preferential interest rates.

17. Housing Technology Improvement Program (HTIP)

This is another CMHC program which is designed to encourage the development, demonstration, and documentation of new ideas for improving the performance of housing. A maximum of $10,000 is available for each proposal with the requirement that the product or project be tested and demonstrated and a report be submitted to CMHC on the performance.

18. Heating Costs and Minimum Qualifying Incomes

The objective of this CMHC regulatory program is to provide an incentive to increasing the energy efficiency of housing stock and reduce the risk of mortgage defaults due to heating costs claiming an excessive proportion of occupant's incomes. The policy consists of a change in the approach for computing minimum qualifying income for home purchasers to consider expected heating costs.

19. National Energy Audit Program (NEAP)

This program provides audits, information, and financial incentives to assist industrial, commercial, and institutional sectors to conserve energy. On-site analysis of energy use is provided through the Energy Bus Program and assistance is provided in the form of grants for consultants to help plan and implement projects with significant energy savings. Government-owned buildings are not eligible for the consulting assistance grants. Seminars and workshops covering a wide variety of energy conservation topics are held for middle management and technical staff.

20. Residential Insulation Contractor Certification Listing Program

This regulatory program of the Canadian General Standards Board (Supply and Services) also includes training and examination of insulation contractors. It is a voluntary program. CGSB reviews information on business practices and estimator and installer knowledge before certifying a contractor.

21. Indian and Northern Affairs Conservation Program

This federal department is formalizing an internal program for reducing energy consumption in buildings which it owns. The department owns property in some of the small communities considered and, of these, there are buildings which could benefit from investment in energy saving measures.

Provincial Programs

1. Residential Awareness Program

   This information program is aimed at the residential sector. The objective is to increase public understanding of energy conservation measures through advertising campaigns and publications on how to save energy. Twelve publications are distributed widely through government agencies, hardware stores, utility companies, and on direct request.

2. School Curriculum Support Program

   The objectives of this educational program are to research, develop, test, publicize, and distribute supporting materials in the energy conservation field for use in Alberta schools. The program also includes curriculum development and teacher training.

3. Rural School Visitation Program (RSVP)

   This program is designed to introduce concepts of energy conservation and renewable energy to students and teachers. An experienced team of two travels to schools on request, presenting material mainly to elementary grades.

4. Utility Company/Government Joint Programs

   The objective of this program is to provide useful, accurate supporting information and promotional material on energy conservation in the residential, industrial, and commercial sectors. It includes newsletters, films, seminars and a speakers bureau.

5. Industrial Energy Conservation Program

   This program includes the Energy Bus program partly funded by the federal government. Its aim is to increase the awareness of potential energy savings in business, industry, and institutions.

6. Innovative Housing Grant Program

   This is a research and development program administered by Alberta Housing and Public Works. It is designed to assist in researching the areas of housing costs, energy efficiency, and alternative forms of housing.

7. Schools Conservation Program

With this program the Education Department plans to demonstrate the financial benefits and technical feasibility of energy conservation retrofits and improved energy management practices in Alberta Schools. The pilot project involved 52 schools in different parts of the province and the program is being expanded.

8. Energy Awareness Program

This information program is designed to inform operators of the energy savings which can be achieved through better practices. All public recreational facility operators are eligible for the seminars, publications, and audio-visual presentations.

9. Energy Management Group - Alberta Government Services

This program is aimed at provincial government-owned and operated buildings. Information on energy use is collected and monitored and advice is given to physical plant operators on energy saving measures.

10. Rural Housing Assistance Program

This program is not aimed specifically at energy savings but such savings may accrue under the program. Grants are available for replacing or repairing houses in small and isolated communities. This program has been in operation for six years and, using local labour and materials to the extent possible, better quality housing is provided. The new houses are incorporating energy saving features, particularly extra insulation and high quality double-glazed windows.

11. Remote Area Heating Allowance

This rebate program is aimed at those households in areas which are not served with natural gas. Users of propane and heating oil may receive rebates of 35 percent of their fuel costs.

12. Rural Electrification and Rural Gas Co-ops

Under these long-standing programs, the provincial government provides technical, financial, and managerial assistance to rural areas which form organizations to supply gas or electricity.

13. Electric Energy Marketing Agency

This recently formed agency is authorized to purchase the bulk power generated by the utility companies and to sell it back to the distribution companies. The intention is to provide electricity to all Albertans at the same price. The program has direct relevance to the remote communities where the price of electricity was recently reduced.

14. Alberta Seniors' Home Improvement Program

This program provides grants of up to $3,000 to those senior citizens who meet certain income tests for home improvements including heating systems, electrical or gas connections, appliances, insulation, and various other items.

ANNEX B

Data on Energy Consumption for Northlands School Division Facilities in Remote Communities

Volume of Propane at Average Cost (litres)

Community	School/ Res	1981	1982	Percent Increase
Fort Chipewyan	Res.	41,430	59,450	43.5
Chipewyan Lake	School	18,800	22,900	21.8
	Res.	18,800	15,300	- 18.6
Jean d'Or Prairie	School	92,212	115,200	25.5
	Res.	117,400	147,200	25.4
Fox Lake	School	110,000	187,000	[illegible]
	Res.	145,600	165,000	13.3
Trout Lake	School	33,200	42,850	[illegible]
	Res.	33,200	40,100	[illegible]
Peerless Lake	School	29,200	52,100	[illegible]
	Res.	29,200	52,100	78.4

	Electricity 1981	Electricity 1982	Propane 1981	Propane 1982	Diesel 1981	Diesel 1982
Fort Chipewyan School (1972)	6,659.74	8,937.73			16,866.72	16,347.90
Residences (3)	1,962.19	3,712.80	6,930.52	11,776.57		
hipewyan Lake School	816.12	1,119.15	3,148.29	4,543.69		
Residences (2)	1,119.15	1,371.75	3,148.29	3,029.12		
ean D'or School (1974)	20,182.87	32,229.65	15,427.08	22,913.34		
Residences (7)	3,996.59	7,158.19	19,634.48	29,162.54		
ox Lake School (1979)	20,901.38	28,123.96	18,381.15	37,033.70		
Residences (11)	7,184.08	11,443.59	24,365.72	32,681.03		
rout Lake School (1980)	3,007.04	17,717.99	5,549.58	8,468.05		
Residences (2)	1,065.78	1,436.45 (3)	5,549.58	7,938.11		
eerless Lake School (1980)	5,677.23	17,755.26	4,878.38	10,320.18		
Residences (2)	1,661.38	2,957.76 (3)	4,878.38	10,320.20		
arden Creek School	9,980.81	29,107.75	7,015.77	5,152.06		
Residences (2)	Included in school	- Div. power Plant	1,045.01	1,467.98	1,045.01	1,467.98

Average cost of propane 1981 was 16.73 per litre

Average cost of propane 1982 was 19.81 per litre

Average cost of diesel fuel 1981 was 26.66 per litre

Average cost of diesel fuel 1982 was 33.60 per litre

Source: Northlands School Division

ANNEX C

Alberta Power Tariff Schedule

for Isolated Service

Effective: [illegible]
Applicable to billings
1982 02 01
Supersedes: 1982 02 01

RATE SCHEDULE 13

RESIDENTIAL SERVICE

AVAILABLE: To all customers not situated within the boundaries of an incorporated community in which the Company serves more than 100 customers.

APPLICABLE: To single-phase electric service at secondary voltage through a single meter, for normal use by a single and separate household. Not applicable to any commercial or industrial use.

RATE: Charges for service in any one billing month shall be the sum of the following:

(a)	Customer Charge	$8.6[illegible]
(b)	Energy Charge	
	For the first 300 kW.h	11.66¢ kW.h
	For the next 300 kW.h	8.34¢ kW.h
	All over 600 kW.h	5.92¢ kW.h

MINIMUM MONTHLY BILL: Shall be the Customer Charge.

RATE MODIFICATIONS & RIDERS: [illegible] of this schedule are [illegible] of the appropriate surcharge [illegible] tax, see Rider A-1. For isolated service the [illegible] this schedule are subject to the addition [illegible] surcharge, see Rider A-2. For [illegible] on net return, see Rider C.

ELECTRIC SERVICE REGULATIONS: The Company's Electric Service Regulations [illegible] by the Public Utilities Board for the Province of Alberta form part of this rate schedule and apply to the Company and every customer supplied with electric service by the Company in the Provinces of Alberta and [illegible]. Copies of the Electric Service Regulations are available for inspection in the offices of Alberta Power Limited during normal working hours.

RATE SCHEDULE 23

GENERAL SERVICE

AVAILABLE: To all customers not situated within the boundaries of an incorporated community in which the Company serves more than 100 customers.

APPLICABLE: To any use of electric energy not inconsistent with safe and adequate service to all customers of the Company, except as more favourable options may apply.

RATE: Charges for service in any one billing month shall be the sum of the following:

(a) Demand Charge

All kW of billing demand	$3.52 per kW

(b) Energy Charge

For the first 200 kW.h per kW of billing demand	10.03¢/kW.h
For the next 200 kW.h per kW of billing demand	6.95¢/kW.h
For energy in excess of 400 kW.h per kW of billing demand	5.62¢/kW.h

MINIMUM MONTHLY BILL: Shall be the Demand Charge.

BILLING DEMAND: The billing demand may be estimated or measured and will be the greater of the following:

a) the highest metered demand during the billing period;
b) the highest metered demand during the 12 months ending with the current billing month, excluding the months April through September;
c) the estimated demand;
d) 5 kilowatts.

POWER FACTOR: Where a customer's power factor is found to be below 80 percent, the Company may require such customers to install corrective equipment.

...continued on overleaf

RATE MODIFICATIONS APPLICABLE:

The rates on this schedule are subject to the addition of the appropriate surcharge for franchise or municipal tax, see Rider A-1.

For isolated service the rates on this schedule are subject to the addition of a surcharge, see Rider A-2.

For customers having small constant loads, whose monthly energy requirements can be estimated closely, see Rider D.

An optional minimum charge provision based on annual rather than monthly use is provided for in Rider G.

For customers served at primary or transmission voltages or owning their own transformers, see Rider H.

ELECTRIC SERVICE REGULATIONS:

The Company's Electric Service Regulations approved by the Public Utilities Board for the Province of Alberta form part of this rate schedule and apply to the Company and every customer supplied with electric service by the Company in the Provinces of Alberta and Saskatchewan. Copies of the Electric Service Regulations are available for inspection in the offices of Alberta Power Limited during normal working hours.

RIDER A-2

SURCHARGE FOR SERVICE IN ISOLATED AREAS

AVAILABLE: In isolated areas.

APPLICABLE: To all electric service from local power plants.

RATE: Service will be rendered at residential and general service rates available to similar territory served by the interconnected system, with added surcharges to cover the higher cost of power supply as follows:

For the first 500 kW.h	0¢ per kW.h
For all kW.h over 500 kW.h	9.05¢ per kW.h

NOTE:

1. Special arrangements will be required for supply to loads exceeding 20 kW in these areas.
2. Electric service will not be offered for electric heating purposes.

RIDER F

The Electric Energy Marketing Act Adjustment

AVAILABLE: Throughout the territory served by the Company.

APPLICABLE: To all electric service except as noted below. (1)

RATE: (2) The applicable rates will be reduced by the amount by which the Company charges to the Electric Energy Marketing Agency (the Agency) for energy deemed to be delivered to the Agency exceeds the Agency charges to the Company for the same quantity of energy. Such excess will be credited to the Company's customers' bills by applying a uniform percentage adjustment to amounts determined under the applicable rates.

(1) The following are exempt from this Rider.

a) Rider E (See also the Main Transmission Facilities Charge of Rate Schedule 33 and the Supplementary Power Supply of Rate Schedule 34).

b) The Extension from Main Transmission Facilities Charge Rate Schedule 33.

c) Rate Schedule 36.

d) Rate Schedule 01.

(2) This Rider does not include any amounts in respect of income tax rebates.

ANNEX D

Fort Providence Wood Gasification
Project Summary and Present Value
of Costs for 25 Years

Estimated Present Value of Costs (over 25 Years) for Energy Supply at Fort Providence

All costs are in 1982 dollars and values for savings and capital costs are taken from the Project Summary. Price escalation of diesel oil is obtained from EMR, NEP Update 82. From 1982 to 1990 real escalation is 3.3 percent per annum while it is 2.6 percent from 1991 to 2000. The average from 1982 to 2000 is 3.0 percent.

1. Wood Gasifier, 25-year Cost	Present Value
Capital Charges	
25-year life, fully recovered	$ 523,500
Operating Costs	
2% of capital per year, Discounted at 6%	134,000
Wood Cost	
No growth in demand	
$45 per cord	323,000
Total Present Value:	$ 980,500

2. Diesel and Heating oil, 25 - year cost	
Diesel Fuel	
1983 - 2007, Real Growth = 3%	
Discounted at 6%	$ 630,000
Operating and Maintenance at 5% of fuel	31,000
Heating Fuel	
1983 - 2007, Real Growth = 3%	
Discounted at 6%	165,000
Capital Charges	
120 kW at $1,500/kW, fully recovered	180,000
Total Present Value:	$1,006,000

3. Diesel and heating oil, 25-year cost with no price escalation	
Diesel Fuel	
1983 - 2007	$ 463,000
Operating and Maintenance at 5% of Fuel	23,000
Heating Oil	
1983 - 2007	121,000
Capital Charges	
120 kW at $1,500/kW, fully recovered	180,000
Total Present Value:	$ 787,000

Energy, Mines and Resources Canada | Energie, Mines et Ressources Canada

Northwest Territories Government Services

Electrical Power From Wood

Project Summary

Canada/Northwest Territories Conservation and Renewable Energy Demonstration Program

Project Location:
Fort Providence, N.W.T.

Project Number:
12-200-704-1

Sector:
Wood Gasification

Project Manager:
Sieg O. Philipp

Status:
Complete

Province:
Northwest Territories

Date:
May 1982

Technology:
Generation of Electricity by a renewable energy source "Wood"

Purpose:
To demonstrate the feasibility of an automated wood gasification plant as the supplier of power and heat to a 37,000 sq. ft. complex formerly served by diesel.

Description:
Wood gas from the gasifier will fuel the engine which in turn will power the 120 K.W. generator. The jacket heat from the engine radiator as well as the exhaust heat will be recaptured for community heating.

Contributors:

Snowshoe Inn Ltd. —	$250,000.00
Canada/N.W.T. Program —	$273,500.00
	$523,500.00

Expected Benefits Savings:
Projected savings on diesel fuel of 36,850 gal. or $10,936 in the first year of operation. Employment for the largely unskilled local labour force. Use of an abundant local renewable resource instead of imported fossil fuel. The real benefits of this project will be apparent if and when it is extended to provide community power and heat. To determine the feasibility of manufacturing wood gasification plants in Fort Providence.

Further Information:
Tours and information available on site. A slide show and a comprehensive engineering report will be produced following one year of operation.

Information Contact:
S.O. Philipp, Snowshoe Inn, Fort Providence, N.W.T. X0E 0L0. Tel.: (403) 699-3511. Energy Conservation Division, Department of Government Services, Government of the Northwest Territories, Yellowknife, N.W.T. X1A 2L9. Tel: (403) 873-7203.

Economic Analysis

Project costs

Capital	$344,127	
Engineering	25,760	
Installation	138,613	
Total installed cost		$508,500
Monitoring and technology transfer	15,000	
Total demonstration cost		$523,500

Operating costs

Pre-demonstration annual fuel cost. Diesel – 36,900 gal. @	$36,200
Post-demonstration annual fuel cost. Wood – 562 cords @	$25,300
Net annual fuel savings	$10,900
Saving by recovery of excess heat	9,500
Total saving	$20,400

Fort Providence now consumes approximately 159,450 gallons of diesel fuel for electrical generation and 152,400 gallons of heating fuel. As the price of fossil fuel increases, the projected 1985 community savings, given a price of $2/gallon for oil and $65/cord for wood, could be $465,660.

Monitoring/Evaluation

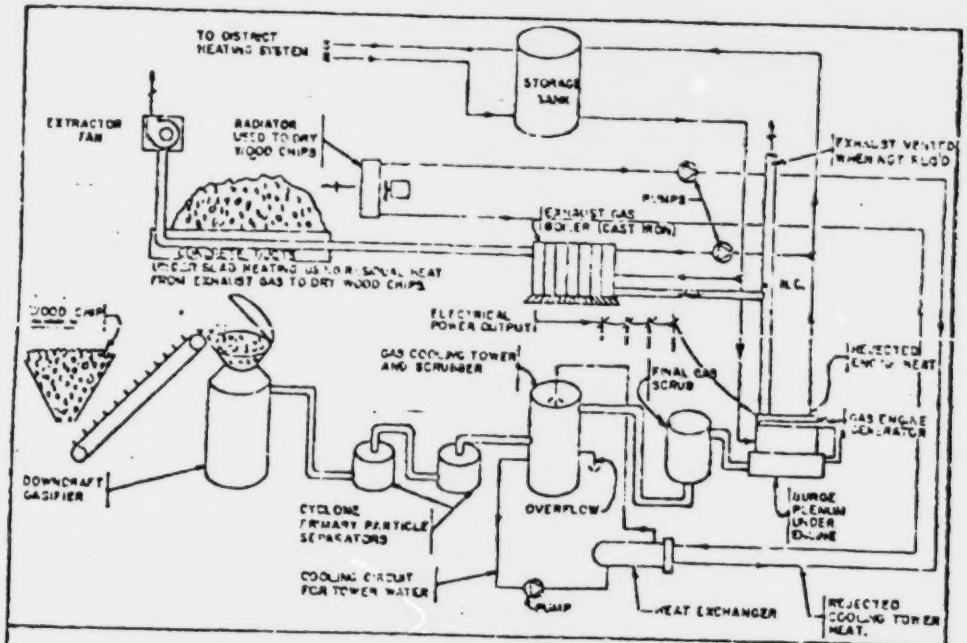
The gasifier was assembled and tested in West Germany. The Snowshoe Inn is maintaining daily progress and modification records, to be made available in the all-inclusive engineering report. Monitoring and further modifications will be carried out as required.

Technical Details/Specifications

Main components are:

One – 40" x 100" insulated steel building, concrete footing and floor
One – Imbert wood gasifier system type 26/95/200/100
One – 134 KW watercooled woodgas engine and heat exchanger
One – 120 KW three phase brushless generator and control system
Two – KOPO PH-10 Hogger Wood Chippers by Hakmet Ltd.

Schematic Diagram:



FORT PROVIDENCE WOOD GASIFIER PROJECT

ANNEX E

Costs of Natural Gas Service to

Jean d'Or Prairie and Chipewyan Lake

ANNEX E

Costs of Natural Gas Service to Jean d'Or Prairie and Chipewyan Lake

I. Jean d'Or Prairie

The cost estimating procedure for the natural gas transmission and distribution is based on that used by the Alberta Department of Utilities and Telephones. Assumptions for the estimates of future costs are given in the text of the report. A 6% discount rate is assumed.

1. Transmission

50 kilometres of 50 mm aluminium transmission pipe @ $9400 per km.	$ 470,000
one regulator station	3,000
three creek crossings @ $20,000	60,000
cathodic protection and x-ray inspection	15,000
surveying at $750 per km.	37,500
Total Construction Costs:	$ 585,500
General Contingency (5%)	29,300
Right-of-Way damages Contingency (1%)	5,900
Engineering and Overhead (20%)	117,100
Transmission Sub-total	$ 737,800

2. Distribution

Total Estimated for 85 connections	$ 250,000
Total Transmission and Distribution	$ 987,800

3. Conversion Costs

Replacing Diesel Engines	
one 300 kW engine	160,000
one 200 kW engine	110,000
Less: salvage value of diesels (@ $50/kW)	(23,000)
Net Cost:	247,000
Converting propane appliances to natural gas	10,000
Total Conversion Costs	$ 257,000
Total Capital Cost:	$ 1,244,800

4. Present Value, 25 years of diesel, propane, heating oil

	Present Value
Diesel Fuel	
taken as a proportional share of cost in Annex F for Jean d'Or Prairie and Fox Lake combined	$ 3,665,000
Propane	
annual demand = 263 m^3; 1982 price = 19.5 cents/litre escalation = 3%	893,000
Heating Oil	
annual demand = 45 m^3 1982 price = 34 cents/litre escalation = 3%	266,000
Total Present Value:	$ 4,824,000

5. Present Value of Costs of Gas System, 25 years

Gas Requirements

1982 = 18,670 GJ
1990 = 30,380 GJ
2007 = 30,380 GJ
1982 price = $3.42/GJ
escalation = 3%

Gas Cost

1983 - 1990	$ 593,000
1991 - 2007	1,086,000

Other Annual Costs

Capital recovery 6%, 35 years =	$ 86,000
Operating & Maintenance =	25,000
Total:	$111,000

25 years @ $111,000, discounted at 6% 1,419,000

Total Present Value: $ 3,098,000

II Chipewyan Lake

1. Transmission Lines

8 km at $9,400	75,000
regulator station	3,000
cathodic protection and x-ray inspection	10,000
survey	6,000
Sub-total	$ 94,000
General contingency (5%)	4,700
Right-of-Way damages Contingency (1%)	900
Engineering and Overhead (20%)	18,800
Transmission Total	$ 118,400

2. Distribution

Total Estimated for 50 connections	$ 180,000

3. Conversion Costs

Natural Gas Engines	
2 x 50 kW @ $500/kW	50,000
(Assume salvage value of diesels = installation cost)	
Other conversions	5,000
Total Capital Costs	$ 353,400

4. Present Value, 25 years of diesel and propane

Diesel Fuel Requirements*

1982 = 70 m^3 @ 33.1 cents/litre		
1983 - 1990;	Real Growth = 15.9%	$ 290,000
	Discounted at 6%	
1991 - 2007,	Real Growth = 2.6%	641,000
	Discounted at 6%	

Operating and Maintenance

1983 - 1990	22,000
1991 - 2007	31,000

Propane Requirements

1982 = $8,800		
1983 - 1990,	Real Growth = 18.3%	123,000
	Discounted at 6%	
1991 - 2007,	Real Growth = 3%	$279,000
	Discounted at 6%	
	Present Value, Existing System	$1,386,000

* Real growth is a combination of growth in generation (12.6%) and in price (3.3%)

5. Present Value, 25 years of Natural Gas System

Gas Requirements

1982	= 3,660 GJ
1990	= 10,050 GJ
1982 price	= $3.42/GJ
Escalation	= 3%

Gas Cost

1983 - 1990	$ 161,000
1991 - 2007	359,000

Other Annual Costs

Capital recovery 6%, 35 years =	$ 24,000
Operating & Maintenance =	7,000
Total:	$ 31,000

25 years @ $31,000, discounted at 6%	396,000
Total Present Value:	$ 916,000

ANNEX F

Costs of Electricity Supply for
the Period 1983 - 2007

I. Fort Chipewyan
II. Jean d'Or Prairie and Fox Lake

ANNEX F

Costs of Electricity Supply for the Period 1983- 2007

I Fort Chipewyan

1. Assumptions for electricity supply to Fort Chipewyan

i. Diesel

a. Average growth in consumption = 9.2% p.a. to 1990, then 0%
b. Average growth in diesel price = 3.3% p.a. 1982-1990
c. Peak demand grows at the same rate as consumption reaching 2,062 kW in 1990
d. 1982 rate capacity = 2,400 kW
peak demand = 1,020 kW
e. Capacity to be installed in 1987 = 500 kW
cost = $1,500 per kilowatt, 25-year life
f. Annual operating and maintenance costs = 0.5 cents/kWh + 4% of fuel costs
g. Discount rate is 6% p.a.
h. No capital charges are made for existing plant

ii. Transmission Line from Fort MacKay @ 72 kV, 175 km

a. Capital cost = $62,500 per km., recovered over 35 years
b. Annual operating cost = 2% of capital costs
c. Substation cost = $500,000
d. Cost of energy from the grid = 5.6 cents/kWh, no escalation

2. Present Value of 25-year costs for diesel-based system

		Present Value (thousands)
Fuel Costs		
1983 - 1990,	Real Growth = 12.5%* Discounted at 6%	$ 4,250
1991 - 2007,	Real Growth = 2.6% Discounted at 6%	8,390
Operating and Maintenance Costs		
1983 - 1990		347
1991 - 2007		586
Capital Charges, New Plant		
1988 - 2007,	Twenty years of 25-year life Discounted at 6%	503
	Total Present Value:	$14,076

* Combination of real growth in generation and in price. Cost in 1982 was $396,000 while generation was 3,815 MWh.

3. Present Value of 25-year costs for grid-based system

Total Capital Costs, 72 kV Transmission Line

175 km at $62,500	$10,940,000
Substation	500,000
	$11,440,000

Annual Charges

Capital recovery, 35 yrs, 6%	$ 790,000
O & M, 2% of Capital	230,000
Total Annual Charges:	$ 1,020,000

	Present Value (thousands)
Capital Charges, 1983 - 2007 (including operation and maintenance)	$13,036
Costs of Electricity ($0.056/kWh)	
1983 - 1990, Growth = 9.2% Discounted at 6%	1,960
1991 - 2007, Growth = nil Discounted at 6%	2,830
Total Present Value:	$17,846

4. Present Value of 25 year costs for diesel-based system without price escalation

Fuel Costs	
1983 - 1990, Real Growth = 9.2% Discounted at 6%	$ 3,675
1991 - 2007, Real Growth = nil Discounted at 6%	5,261
Operating and Maintenance	
1983 - 1990	324
1991 - 2007	460
Capital Charges, New Plant	503
Total Present Value:	$10,223

II Jean d'Or Prairie and Fox Lake

1. Assumptions for electricity supply for Jean d'Or Prairie and Fox Lake (1983 - 2007)

i. Diesel

a. Average growth in consumption = 9.6% p.a. (1983-1990)
0% p.a. (1990-2007)
b. Fuel Cost escalation = 3.3% p.a. 1983 - 1990
= 2.6% p.a. 1990 - 2007
c. Peak demand grows at 9.6% p.a. to 753 kW in 1990: from 1982 = 363 kW
d. 1982 rated capacity = 950 kW
e. Install 2X 200 kW = 400 kW in 1987
Total Capacity = 1,350 kW
Cost = $1,500/kW or $600,000
f. Annual operating and maintenance costs = 0.5 cents/kWh + 4% of fuel costs
g. Discount rate is 6% p.a.
h. No capital charges are made for existing plant

ii. Transmission Line from Fort Vermilion

a. Required 90 km of 25 kV line @ $20,000/km
b. Two substations at $150,000 each
c. One river crossing @ $150,000
d. Operating cost = 2% of Capital
e. Cost of energy from the grid = 5.6 cents/kWh, no escalation

2. Present Value of 25-year costs for diesel-based system

		Present Value (thousands)
Fuel Costs*		
1983 - 1990,	Real Growth = 12.9% Discounted at 6%	$ 2,150
1991 - 2007,	Real Growth = 2.6% Discounted at 6%	4,294
Operating and Maintenance Costs		
1983 - 1990		153
1991 - 2007		269
Capital Charges, New Plant —		
1988 - 2007,	Twenty years of 25-year life Discounted at 6%	403
	Total Present Value:	$ 7,269

* Fuel costs in 1982 were $197,000 for generation of 1,422 MWh. The real growth in costs is a combination of growth in generation (9.6%) and price (3.3%)

3. Present Value of 25-year costs for grid-based system

Total Capital Costs, 25 kV

95 km at $20,000	$ 1,800,000
Two Substations	300,000
River Crossing	150,000
Total	$ 2,250,000

Annual Charges

Capital recovery, 35 yrs, 6%	$ 155,000
O & M, 2% of Capital	42,000
Total Annual Charges:	$ 197,000

	Present Value (thousands)
Capital Charges, 1983 - 2007 (including operation and maintenance)	$ 2,518
Costs of Electricity ($0.056/kWh)	
1983 - 1990, Growth = 9.6% Discounted at 6%	750
1991 - 2007, Growth = nil Discounted at 6%	1,089
Total Present Value:	$4,357

4. Present Value of 25 year costs for diesel-based system without price escalation

Fuel Costs

1983 - 1990, Real Growth = 9.6% Discounted at 6%	$ 1,856
1991 - 2007, Real Growth = nil Discounted at 6%	2,695

Operating and Maintenance

1983 - 1990	141
1991 - 2007	205
Capital Charges, New Plant	403
Total Present Value:	$ 5,300